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One of 4 sets water-cooled turning vanes installed in Boeing wind tunnel. See story on page 52.

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A MONTHLY
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AND CONTRACTORS CONCERNED WITH
COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

HEATING AND VENTILATING

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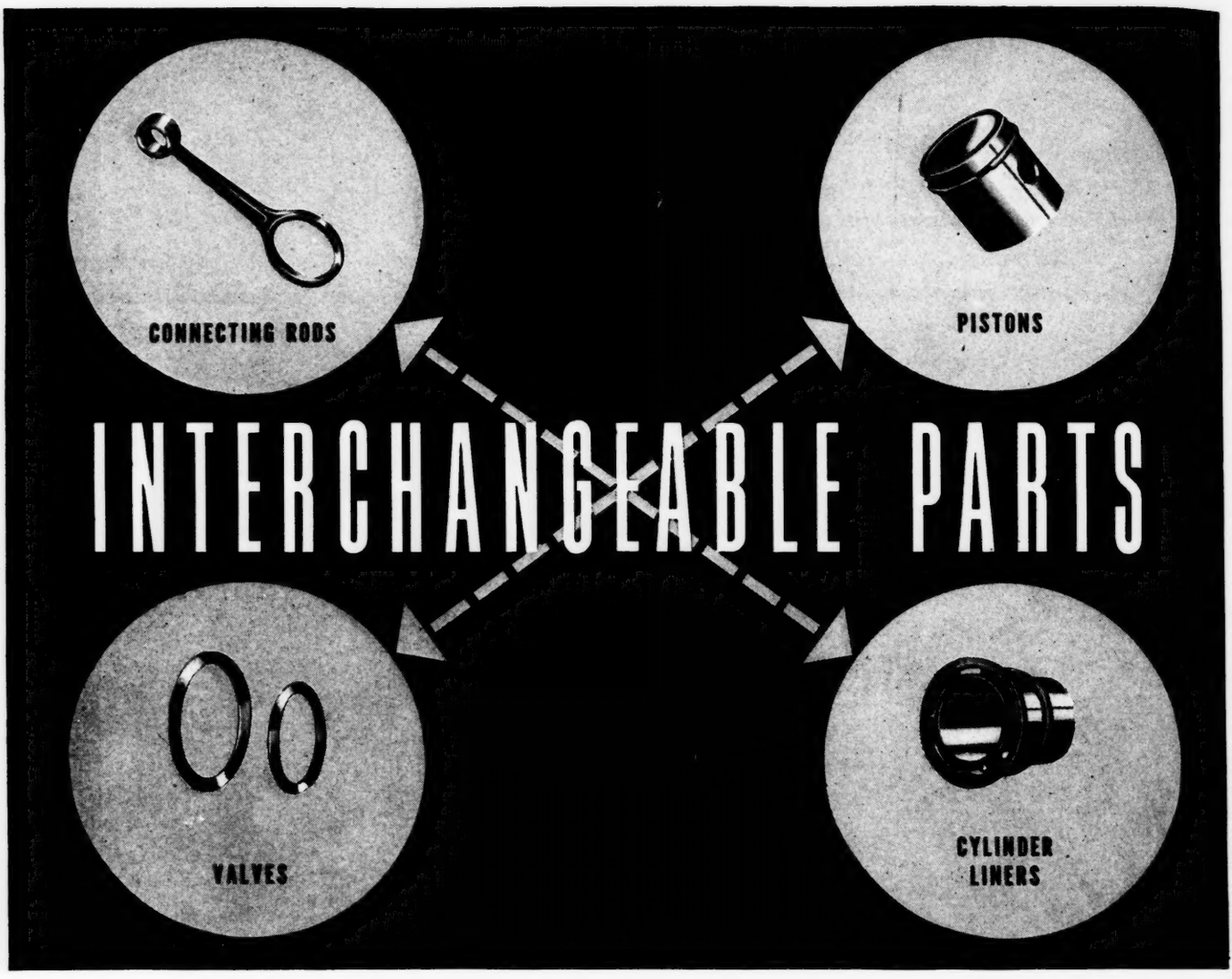
NEXT MONTH'S ISSUE

Just what the consulting engineer is thinking about for the post-war period is summarized in a series of articles. The first article, in this issue, is on the subject of fuels, while in the next month's issue, will be presented consulting engineers' thoughts on radiant, hot water and steam heating.



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Process Piping in Industrial Plants

HARRY D. UNWIN
Mechanical Engineer, Albert Kahn Associated Architects & Engineers, Inc.

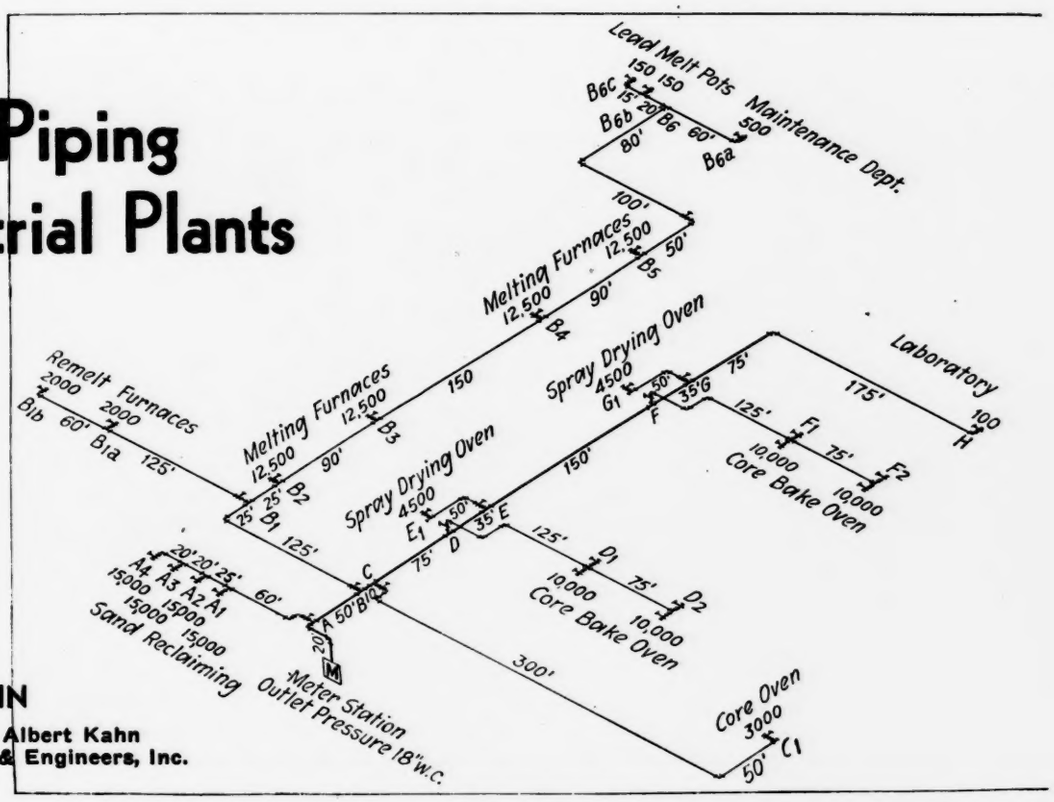


Fig. 1. Layout of an aluminum factory piping for plan view shown in Fig. 2.

THE importance of process piping to the efficient functioning of equipment and economy of manufacturing operations cannot be over-emphasized. Too many times it is over-shadowed by the more imposing architectural and structural features.

It is quite probable that the post-war era will see the conversion of many plants to the manufacture of products not contemplated at the time of construction. In such cases, the lighting, plumbing, heating, and ventilating systems, as part of the original buildings, may require little, if any, alterations; but the process piping, which depends upon the arrangement of equipment, may require complete revamping; at least, a very careful check-up will be needed to ascertain to what extent the existing mains and branch services can be utilized.

With the foregoing in mind, a series of articles, of which this is the first, is contemplated, dealing especially with the practical problems of sizing mains and other data pertinent to industrial piping systems for such fluids as fuel gas, petroleum products, compressed air, process steam and water, and other gases and liquids.

Gaseous Fuels

Many types of equipment use gas as a fuel. It is, therefore, most important to start with the equipment layout of the foundry, forge shop, heat-treating department, machine shop, laboratory, kitchen or other fuel-using departments. Selection of equipment and types of burners depends upon the availability and type of the fuel supply. Before the war, cost of equipment and economy of operation were of prime consideration, but under present conditions of nation-wide coordination of resources, conservation of domestic consumption for war purposes is the determining factor of whether to use natural gas or fuel oil, or vice versa. In some cases, liquefied petroleum gases have been used after carefully checking the adequacy of the propane or butane gas supply. There are instances where it has been necessary to provide a propane gas system as a standby against possible temporary interruption of the natural gas supply, in which case a diluter is used to mix air with the propane in proper proportions to produce a propane-air mixture which will burn with characteristics similar to the main gas supply in the plant without undue adjustment of burners and without impeding heat-treating processes. In other cases, because of certain special requirements, the use of gas for heat-treating or stress-relieving is mandatory; and again, it may be desirable to use combination gas-oil burners.

Industrial uses of gas fuel are so extensive that only a few of the many applications can be mentioned. Gas is used to heat melting pots for lead, tin, zinc, and other low melting point metals. Pots for this purpose are constructed of cast iron or pressed steel and may have refractory combustion chambers; others for melting brass may be constructed entirely of refractory and insulating brick with sheet metal protecting jacket. Combustion air for these furnaces may be secured from the factory compressed air system, provided suitable means are employed to dampen out the pulsations. Low pressure blowers are commonly used to provide combus-

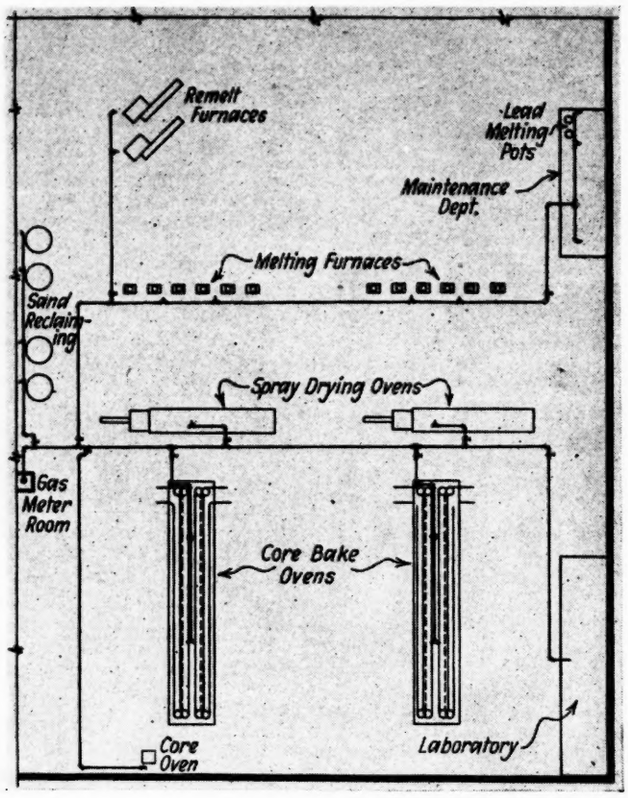


Fig. 2. Plan of an aluminum factory for which piping is sized in accompanying article. An isometric drawing of the piping is sometimes convenient, as illustrated in Fig. 1.

tion air. For certain types of work, so-called "atmospheric" furnaces are used which require neither compressed air nor low pressure blowers; however, due to their generally lower efficiency, they are seldom used for temperatures above 1000F.

Gas-fired furnaces are used for hardening, carburising, normalizing, etc., and in many instances are especially designed to meet unusual conditions of capacity and limiting dimensions. It is quite common to install a series of heat-treating units such as a hardening, normalizing and draw furnace in line with the quench tanks between, thus providing a continuous heat-treating process without manual handling between operations.

There are many products such as cartridge cases, to mention only one, which require extremely close tolerances. For this reason, they are heat-treated in hydrogen-atmosphere furnaces so as to prevent decarburization. The parts leave the quench in a bright condition which minimizes the grinding operations and eliminates sandblasting. The hydrogen may be obtained in bottles or produced by passing air over a bed of hot charcoal, in which case, the hydrogen is treated by the introduction of other materials to improve its purity and remove carbon dioxide. This and other methods of producing the hydrogen atmosphere are somewhat safer, since the necessity of storing and handling bottles of hydrogen at high pressures is eliminated.

Since a slightly negative pressure is maintained in most furnaces, it is customary to provide a "gas curtain" at the doors so as to prevent contamination of the controlled atmosphere when the doors are opened. Gas for this purpose is usually the prevailing fuel gas in the plant and is piped to the furnace together with compressed air. Both are reduced in pressure and piped to the curtain burner through automatically controlled operating valves.

Other types of furnaces utilizing controlled atmospheres are the nitriding furnace in which the nitrogen atmosphere is employed to increase the surface hardness of steels; the bright-annealing furnace in which propane and butane are used in the presence of water vapor; and the carburizing furnace in which propane or butane may be used to impart carbon to the surface of steel being heat-treated. In foundries, gas is used to heat core bake ovens, spray drying ovens, melting furnaces, sand reclaiming systems, and for various other purposes.

Distribution

The distribution of gas can be classified under (1) high pressure distribution and (2) low pressure distribution. The choice depends on the pressure available. It is very important that the utility company supplying the gas guarantee a minimum pressure at the outlet of meters which they install as the terminal of their service main to the plant. Where high pressure gas at 50-150 lb is available in the utility's mains, this is less important than when a large demand is taken from a city's industrial and domestic system. In low pressure distribution, it is unwise to make any assumption regarding the meter outlet pressure which is the point where the factory system usually begins. The difference between assuming a 1 lb per sq in. initial pressure and later finding that the pressure should have been taken at only 13 in. water, will mean that the entire system will be decidedly undersized and may require a booster pump to overcome the erroneous pressure assumption.

High pressure distribution within the factory at 15-20 lb per sq in. gauge is usually more economical in first cost of pipe, valves and fittings, but it may then be necessary to provide pressure regulators at branch mains or at individual furnaces.

Location of equipment, together with the necessary building plans, provides the first step in the design of a gas distribution system. The second step is to obtain the gas consumption of each piece of equipment under varying conditions, such as:

(a) Peak load or maximum demand;
(b) Heating-up demand; and
(c) Holding demand.

Since the gas consumption under these conditions is a function of the gas-burning equipment design, it should properly be furnished by the equipment manufacturer. To these data must be added operating information regarding the simultaneous occurrence of peak loads; whether melting furnaces, for example, operate at the same time as the core ovens; whether any equipment represents standby units; where future equipment may be installed; and any other unusual factors bearing upon the determina-

TABLE 1.—LOW PRESSURE GAS FLOW
(For 100 ft length of pipe, a 1.0 inch w.c. pressure drop, and gas with a specific gravity of 0.55)

Pipe Dia., In.	Flow Cu Ft per Hr.
1	254
1¼	560
1½	865
2	1760
2½	2880
3	5240
4	10950
6	32600
8	66300
10	118000
12	184000

tion of main sizes. A study of the entire layout, load factors and operating conditions oftentimes leads to substantial first cost reductions which might be overlooked if an arbitrary rule were taken to base pipe sizes on the simultaneous occurrence of all peak loads.

The analysis of all these conditions will enable the engineer to relate each load to the total system demand and to economically size the mains.

When peak loads are not concurrent, 75% of the maximum demands may be used for pipe sizing in the absence of more specific information, provided future additions are not contemplated.

Pipe Sizing

Gas distribution piping can be sized according to various methods. The writer uses the Spitzglass formulas, one being for low pressure, the other for high, as follows:

For low pressures, not exceeding 1 lb gage,

$$Q = 3550\left(\frac{hd^5}{SL\left(1+\frac{3.6}{d}+.03d\right)}\right)^{\frac{1}{2}} \quad \ldots\ldots (1)$$

For high pressures, over 1 lb gage,

$$Q = 4830\left(\frac{Pad^5}{SL\left(1+\frac{3.6}{d}+.03d\right)}\right)^{\frac{1}{2}} \quad \ldots\ldots (2)$$

where Q = gas flow, cu ft per hr,
h = pressure drop, inches of water,
S = specific gravity of gas (air = 1.0),
L = equivalent length of pipe, feet,
d = internal diameter of pipe, inches,
P = pressure drop, lb per square inch,
a = mean absolute pressure in pipe, lb per sq in.

Table 1 is a tabular solution of Equation (1) for runs of 100 ft, for common pipe sizes, and for a 1 inch pressure drop, and based on a gas with a specific gravity of 0.55. Corrections can be made for the volume of flow for gases of other specific gravities and other lengths of pipe by use of multipliers. However, in most cases, the pressure drop is the unknown, so that equation (3) which follows is of more consequence in solving low pressure sizing problems.

Referring to the low pressure formula given in the foregoing, transposition gives

$$h = \frac{Q^2SL}{3550^2} \times \frac{d^5}{1+\frac{3.6}{d}+.03d}$$

For any given pipe diameter,

$$h = Q^2SLK$$

where K combines the pipe diameter constant and the value 3550.

If, for a given diameter pipe, the values for a 1 inch pressure drop in a 100 ft line for a .55 specific gravity gas (Table 1) are designated by the subscript std, then the relationship of the standard values to some other set of conditions designated by the subscript 1 is

$$\frac{h_1}{h_{std}} = \left(\frac{Q_1}{Q_{std}}\right)^2 \times \frac{L_1}{L_{std}} \times \frac{S_1}{S_{std}}$$

and since h_{std} in Table 1 is 1.0 inch of water,

$$h_1 = \left(\frac{Q_1}{Q_{std}}\right)^2 \times \frac{L_1}{L_{std}} \times \frac{S_1}{S_{std}} \quad \ldots\ldots (3)$$

Table 2 gives the specific gravities for various gases merely to illustrate the range. Consult the gas utility for actual values, in a given locality.

Example. What would be the pressure drop of 8000 cu ft of gas with a specific gravity of 0.44 flowing through 225 ft of 4 inch pipe?

Solution. Refer to Table 1 opposite 4 inch pipe and find $Q_{std} = 10{,}950$. Then, using equation (3),

$$h_1 = \left(\frac{8000}{10950}\right)^2 \times \frac{225}{100} \times \frac{0.44}{0.55}$$

$h_1 = 0.96$ in. of water.

TABLE 2.—TYPICAL SPECIFIC GRAVITIES FOR VARIOUS GASES (Air 1.0)

Gas	Specific Gravity
Natural	0.56 to 0.89
Acetylene	0.92
Retort Coal Gas	0.42
Coke Oven Gas	0.37
Carbureted Water Gas	0.64
Propane (Gas)	1.52
Butane (Gas)	1.95

Resistance to flow of valves and fittings can be expressed as a length of pipe, the frictional resistance of which is equal to an equivalent length of pipe of the same nominal sizes. Table 3, on the following page, is inserted for ready reference in solving problems.

The values for the "equivalent length" of valves and fittings in Table 3 are expressed in feet and must be added to the actual length of the pipe main. While the equivalent lengths for cocks, elbows and tees are not according to formula, it has been found that they give results on the safe side.

Since there are many instances of low pressure gas distribution within industrial plants, the aluminum foundry shown in Fig. 2 is presented as a prac-

TABLE 3.—EQUIVALENT LENGTH IN FEET OF VALVES AND FITTINGS

Pipe Diameter, In.	Globe Valve[1]	Plug Cock[2]	Elbow[3]	Tee[4]
1	2	½	1	2
1¼	3*	1	2	4
1½	4	2	3	6
2	7	3	5	10
2½	10	4	7	14
3	13	5	9	18
4	20	7	13	26
6	36	12	23	46
8	53	18	35	70
10	70	24	47	94
12	88	30	59	118

[1]From *Kent's Mechanical Engineer's Handbook*, except for 1¼ in. pipe.
[2]Assumed as approximately equal to two-thirds loss through globe valves.
[3]Assumed as approximately equal to one-half loss through elbows.
[4]Assumed as approximately equal to twice the loss through elbows.

tical example of pipe sizing. The production layout indicates only the location of the gas-fired equipment.

Problem. For the sake of simplicity the following conditions are assumed: a gas with a specific gravity of 0.55; peak loads of all equipment are assumed to be concurrent, so that the maximum demand will be used as the simultaneous demand, and consequently, for pipe sizing. Pressure at the meter outlet is assumed at 18 in. w.c. This is rather low since 1 lb of more can usually be expected, but it will serve to bring out the care with which low pressure mains must be sized. The overhead distribution mains only will be considered, although the following discussion and simplified method can be applied to any part of the system. Having assumed the initial pressure (meter outlet) as 18 in. let us also assume an allowable pressure of 8 in. w.c. at each valved outlet on the mains for extension to the burner piping. Low pressure gas burners usually employ a zero governor on the line at each furnace, the inlet pressure to which should be about 6 in. w.c. From these assumptions it is seen that a pressure loss of 2 in. w.c. has been allowed for the sizing of pipe between the overhead distributing system and the zero governors.

According to data available from equipment manufacturers and other sources, the equipment in Fig. 2 consumes the following quantities of fuel under normal operating conditions:

	Cu Ft per Hr, Each	Cu Ft per Hr, Total
2—Core bake oven groups	20,000	40,000
1—Core oven	3,000	3,000
2—Spray drying ovens	4,500	9,000
2—Melting furnace groups	25,000	50,000
2—Remelt furnaces	2,000	4,000
4—Sand reclaiming units	15,000	60,000
2—Lead melting pots	150	300
Laboratory	100	100
Maintenance department	500	500
Total demand, cu ft per hr		166,900

Solution. To facilitate the computation of pipe sizes, it is sometimes helpful to prepare a diagram as shown in Fig. 1 and indicate the loads and distances to the various outlets. Next, tabulate the quantity of gas flowing through each section of pipe, length of each run, number of fittings and shut-off cocks, as indicated by the following table:

Section	Quantity, cfh	Length, Feet	Number of Ells	Number of Tees	Number of Cocks
M-A	166,900	20	2	1	
A-B	106,900	50		1	
B-C	52,100	10		1	
C-D	49,100	75		1	
D-E	29,100	35		1	
E-F	24,600	150		1	
F-G	4,600	35		1	
G-H	100	250	2	1	

This tabulation covers the known data on the trunk main (Meter to H). It can be extended to include the branches in a similar manner. Note that the tees are included with the run of pipe on the mains rather than debiting the branch. In this way, the available pressure at each tee becomes the initial pressure for the branch without further adjustment.

Next, assume a size of pipe for each section and check the allowable pressures at outlets.

To illustrate the method of determining the size of line refer to section C-C_1 in Fig. 1. This part of the problem is to select the proper size of pipe 350 feet long, having 4 elbows and 1 sectionalizing of branch shutoff cock, which will pass 3000 cubic feet of gas per hour having a specific gravity of 0.55. The initial pressure at point C is 15.14 in. w.c. and the final pressure at point C_1 must not be less than 8 in. w.c., a drop of 7.14 inches.

With an assumed diameter of 2 in. and referring to Table 3 the equivalent straight length of pipe would be

350 (pipe) + 3 (cock) + (4 × 5) (elbows) = 373 ft.

Referring to Table 1 the amount of gas which will flow through 100 ft of 2 inch pipe with a 1.00 in. pressure drop is 1760 cfh.

Using equation (3)

$$h = \left(\frac{3000}{1760}\right)^2 \times \frac{373}{100} \times \frac{.55}{.55}$$

= 10.8 in. of water

Since the allowable drop is only 7.14 inches it is evident that the assumption of d = 2 inches is too small. Assume a pipe diameter of 3 inches, and we have

Equivalent length = 350 + 5 + (4 x 9) = 391 ft.

Q for 3 in. pipe, 1 in. of water, for 100 ft = 5240 cfh.

Again substituting in equation (3)

$$h = \left(\frac{3000}{5240}\right)^2 \times \frac{391}{100}$$

= 1.28 in.

The specific gravity is not used as obviously it drops out.

As the pressure drop is so much less than the allowable 7.14 in., it indicates that the correct pipe size is probably 2½ in. It is always wise to check, so substitute the proper values in equation (3) for d = 2½ and

$$h = \left(\frac{3000}{2880}\right)^2 \times \frac{382}{100}$$

$$= 4.13 \text{ inches.}$$

which is within the allowable limit.

The same procedure is followed to determine pipe sizes for other mains and branches. As an example, refer to section A-A_4 in Fig. 1 which is the branch distribution main to the four sand reclaiming units. The problem is to select the most economical sizes of pipe to transmit 15,000 cfh to the outlet valve on the main for each dryer. The calculated gas pressure at point A is 15.90 inches. The permissible pressure at A_1, A_2, A_3 and A_4 is 8 inches w.c. minimum. The over-all allowable pressure drop between A and A_4 is 15.90 — 8 = 7.90 inches. The solution requires that each section be taken as a separate unit and the sum of the section drops compared to the allowable drop.

Section A-A_1: Q = 60,000 cfh; assume an 8 inch pipe and then

L = 60 (pipe) + 70 (2 ells) + 70 (tee) + 18 (cock) = 218 ft.

Using equation (3)

$$h = \left(\frac{60,000}{66,300}\right)^2 \times \frac{218}{100}$$

$$= 1.79 \text{ inches}$$

Section A_1-A_2: Q = 45,000 cfh; assume a 6 inch pipe and

L = 25 (pipe) + 46 (tee) = 71 feet

Referring to Table 1, assuming 6 inch pipe,

$$h = \left(\frac{45,000}{32,600}\right)^2 \times \frac{71}{100}$$

$$= 1.36 \text{ inches}$$

Section A_2-A_4: Q = 30,000 cfh; assume a 4 inch pipe and

L = 20 (pipe) + 26 (tee) = 46 feet, and

$$h = \left(\frac{30,000}{10,950}\right)^2 \times \frac{46}{100}$$

$$= 3.46 \text{ inches}$$

Section A_3-A_4: Q = 15,000 cfh; assume a 4 inch pipe and

L = 20 (pipe) + 13 (elbow) = 33 feet, and

$$h = \left(\frac{15,000}{10,950}\right)^2 \times \frac{33}{100}$$

$$= 0.62 \text{ inches}$$

For permanent records of the calculations, tabulate the data and determine the final outlet pressures for comparison with the allowable pressures to check on the correctness of the assumed pipe sizes.

Section	Load, cfh	Equiv. Length, Ft.	Pipe Dia., In.	Pressure Drop, In. Water	Available Pressure, In.
A	—	—	—	—	15.90
A-A_1	60,000	218	8	1.79	14.11
A_1-A_2	45,000	71	6	1.36	12.75
A_2-A_3	30,000	46	4	3.46	9.29
A_3-A_4	15,000	33	4	0.62	8.67

The column "Available Pressure" indicates that all assumed pipe sizes are correct since each of the outlet pressures exceeds the 8 inch minimum. With a little experience, it is relatively an easy matter to assume reasonable pipe sizes so that the calculations do not become laborious. The sizing of branch lines between the outlets at the overhead mains and the burners at the equipment can be determined by the methods outlined above.

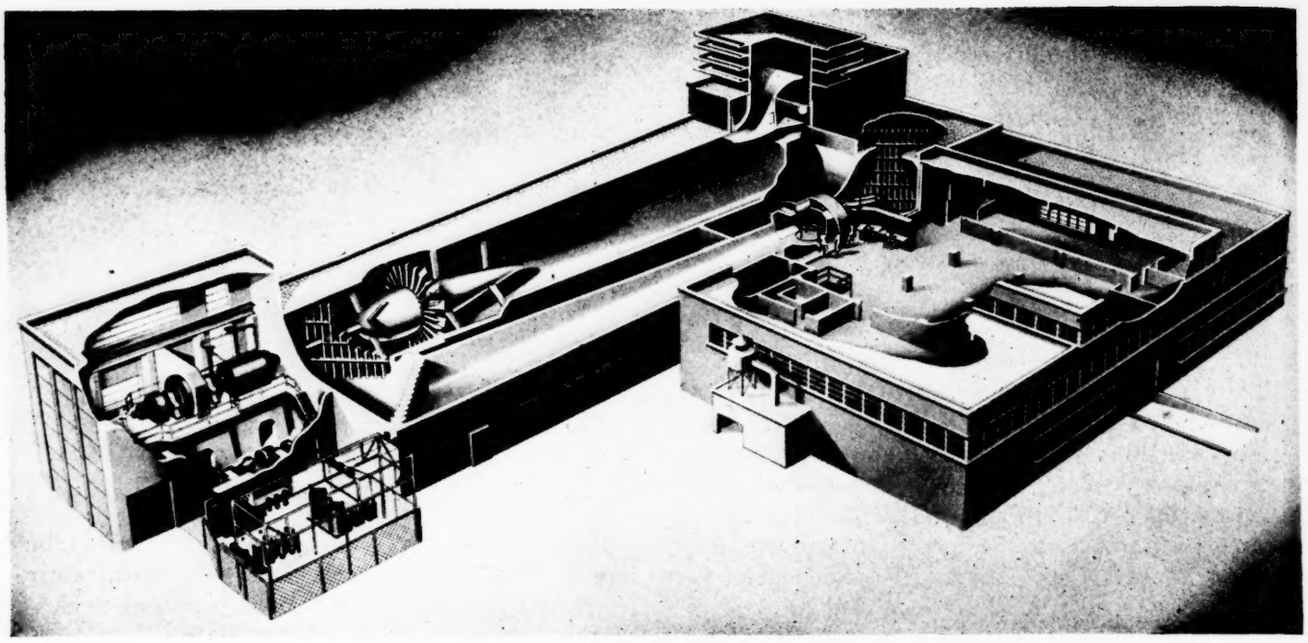
(The concluding installment on gas piping will appear in next month's issue.)

Hot Water Accumulators and Wind Motors

Just prior to the war a Swiss (P. Seehaus), published a report of a study on storing summer surplus energy in Swiss water power in huge insulated hot water accumulators. Shortly thereafter a similar proposal dealing with Danish conditions was published in a Danish technical paper by a Danish engineer, Per V. Bruel. According to his project wind motors should be used as generators of the energy for the heating of residences. Whereas in Switzerland surplus energy is available only during summertime, in Denmark the wind can be utilized more or less during the whole year. The energy stored during the four or five months of summertime can be used as a stand-by source of heat.

The hot water accumulators, which have to be provided in Denmark, are therefore small in comparison with those of the Swiss project. Bruel found that an accumulator with a content of 1500 cubic meters will be sufficient for a building containing 60 rooms. The maximum temperature of the water attained at the end of the summer would amount to approximately 205F. It would decrease during the winter to 120 to 140F, temperatures appropriate for a normal central heating plant.

A good insulation of the accumulator is of greatest importance. It is intended to use powdered peat for this purpose. It will show worth while economies in investment and operation.



Cutaway drawing of the wind tunnel showing the power unit, operations room and office quarters. Features include large fan with hub fairing, air interchanger tower, turning vanes and test section.

Boeing Wind Tunnel Produces 700 mph

AIR velocities as high as 700 mph are possible in the new Boeing wind tunnel recently completed at Seattle, Wash.

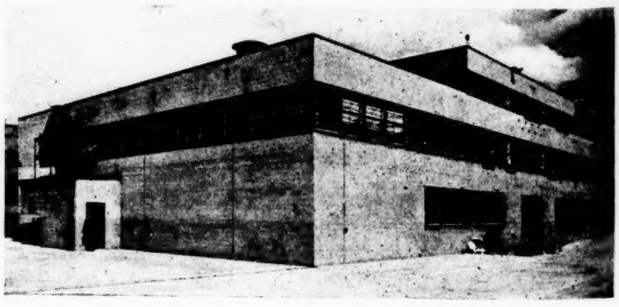
The building in connection with the wind tunnel, which is to be used for model shop, operations floor, offices and drafting rooms, etc., needs no special comment other than that in construction it was absolutely isolated from the wind tunnel itself by an expansion joint that extends through floors, walls, and roof. The entire building and wind tunnel were built on piling driven to 40,000 lb bearing capacity with piling approximately 35 ft long. The foundation of the test section was again isolated from the supports of the tunnel itself and a group of sixteen piling was driven to support the balancing equipment under the test section and to permit the reading of the delicate instruments there installed that might be subject to vibration by the operation of the tunnel.

At the test section, the tunnel is 12 x 8 ft with 2 ft corner fillets. The model is mounted in the test section on a turntable which can be operated to place the model in various positions. There is a movable fairing constructed of plywood. The upper portion of this fairing can be removed in one piece and the two walls are in the form of panels that drop down for access to the model.

In operation with high velocities of 700 miles per hour, a pressure of 1,000 lb per sq ft inward is developed at this section, and a steel pressure cap was designed to enclose the test section. The skin of the pressure cap is 3/16 in. plate reinforced with tees placed at approximately 18 in. on center. This cap is moved back and forth by push button control at the main switchboard.

From the test section the tunnel increases in size to the first corner, where the area is 20 by 20 ft. At the second corner the tunnel is the same size, but at the nacelle the section changes to a circle 24 ft in diameter. Approximately 100 ft from the nacelle, the section is increased to 27½ ft by 27½ ft, excepting at the air interchanger, the size of the tunnel does not change until the bellmouth is reached. In 25 ft, the size of the tunnel is again reduced to 12 by 8 ft at the test section.

Wind velocities vary from a maximum of 700 mph at the test section to approximately 80 mph at the third and fourth corners. Pressure at the test section under maximum wind velocity is 1,000 lb per sq ft. As the velocity changes, the pressure changes



Model building shops and other laboratory facilities serving the wind tunnel. Model building work is on the first floor, directly below the operations floor.

Project of
The Austin Co.
Engineers and Builders

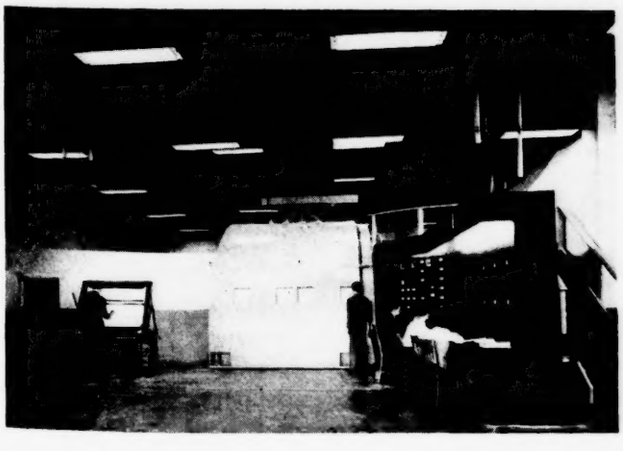
from inward to outward while the air travels through the diffuser section. A maximum pressure of 250 lb per sq ft outward is reached in the nacelle and remains constant from there to the bellmouth.

When operated at high speed, the air completes the 450-foot circuit in less than two seconds. Inasmuch as 11 per cent of the air in the wind tunnel is expelled and replaced with fresh air at every "round trip" for cooling purposes, under high speed operation the air in the tunnel is completely replaced with fresh air three times per minute. A pagoda-like structure, known as an interchanger tower, is located atop the tunnel building and is used for the intake and exhaust of this air.

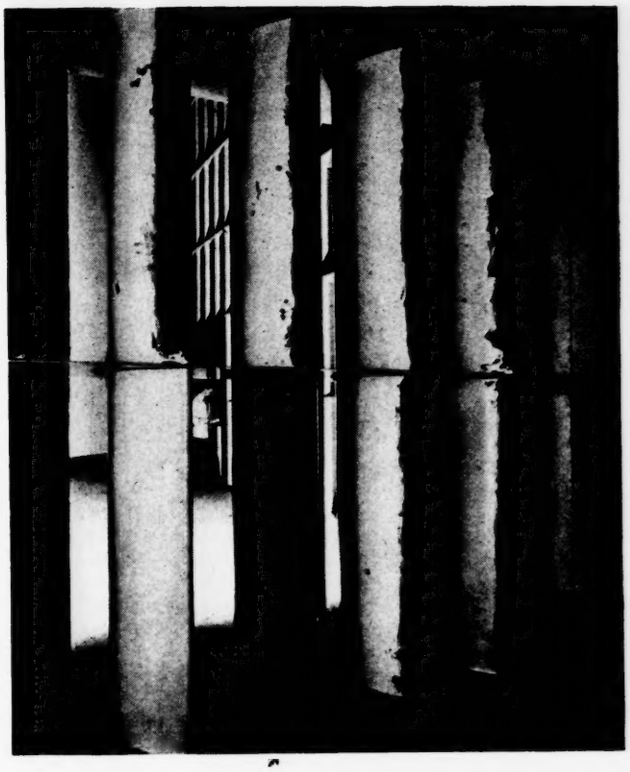
In order to reduce the temperature of the air, two methods are used. The corner vanes at the first, second, third and fourth corners are sprayed on the interior with water, which is wasted. Approximately one-fifth of the air is removed at the air interchanger and fresh air is drawn into the wind stream through the air intake. The amount of air removed at the air interchanger is controlled by a large intake gate valve which is 27½ ft wide by 3½ ft high. The exhaust is 27½ ft by 5 ft 8 in. high. The exhaust gate is rubber sealed.

Corner vanes are made of 12 gauge Armco ingot iron, and are made adjustable for preliminary test. In the final operation of the tunnel, the corners will be welded in place permanently. Water is fed by a centrally located pipe in each vertical series of vanes. Holes are drilled in these pipes to spray the water against the walls of the vane. The air interchanger is in the form of a deflector that removes a portion of the air from the main wind stream.

The tunnel is divided into a number of sections to take care of expansion of the concrete due to the 70F variation in temperature. Certain of the joints are designed to take pressure of 150 lb per sq ft inward and 250 lb per sq ft outward. At one time rubber filler or wedging pieces were considered, but since it was not possible to get a positive connection between the concrete and the rubber, this idea was abandoned.



The control and observation facilities are alongside the welded steel pressure cap which encloses the critical test section. The pressure cap, center, has four observation windows, and is mounted so that it can be moved back and forth. The easel on the left contains a 100-tube manometer to register forces exerted on models under test.

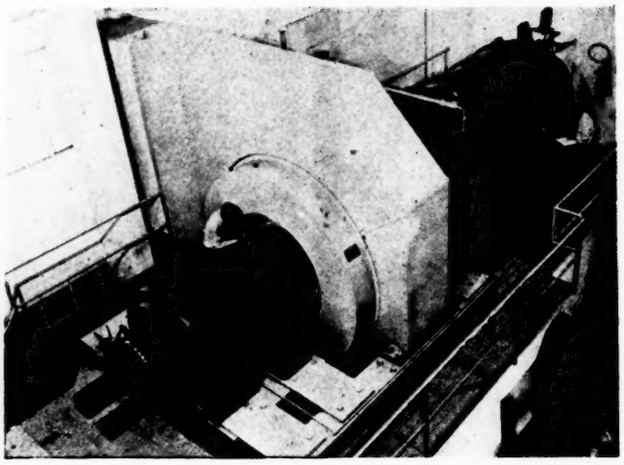


Turning vanes installed at each of the four corners of the 450 ft rectangular bore of the wind tunnel. Cold water circulates in pipes that extend through these vanes and removes the heat generated during high speed operation of the tunnel. After tests to determine what angles will give best results, the vanes will be welded into permanent position.

The wind obtains its velocity by a fan located at the nacelle, which was installed by the Boeing Aircraft Company. An 18,000 hp motor driving a 14 in. solid steel shaft at 514 rpm is the power unit for the 24 ft diameter fan. The shaft at the fan is supported to the tunnel walls by 30 pipe struts. As the revolution of the fan had a tendency to produce a rotation of the wind stream in the tunnel, prerotation vanes are attached to each of the 30 struts. These prerotation fans are movable to an angle of 35 degrees, and adjustment is made at the fan between tests.

In order to reduce the air turbulence, the nacelle is installed about the operating mechanism for the prerotation vanes. Under normal operation, no particularly excessive vector moment is developed at the fan, but due to a possibility of the fan shedding a portion but not all of its blades, the struts and the exterior supporting concrete had to be designed to provide for approximately 250,000 foot pounds of vector movement.

The forward part of the nacelle is constructed of 12-gauge metal skin fastened to bent angle rings. Access doors are provided into the nacelle, as it is the intention on some tests to place an observer in



Power for the wind tunnel is supplied by this 18.000 hp Westinghouse motor encased in the light colored hood. Beyond is the magnetic coupling or clutch built by the Dynamatic Corp., which controls the fan speed with great accuracy. In front of the main motor is the 400 hp Westinghouse starting motor.

the nacelle to watch the operation of the fan. The rear portion of the nacelle is of wood built up on laminated plywood ribs. The nacelle is supported before and aft of the fan by steel struts which are encased in fairings of 12-gauge sheet metal.

A number of access doors were provided into the tunnel, and of necessity these doors had to be flush on the inside of the tunnel without any hardware protruding from the face of the door. Some doors had to be designed for inward pressure, others for outward, and some for both inward and outward. In general these doors were built of wood framed with steel and sealed with rubber gaskets and special locking devices to prevent chatter.

Perhaps the most interesting piece of construction was in the shaping of the bellmouth. As tolerances for the construction of the concrete from the bellmouth through the diffuser section were confined to such very close limits with a permissible variation of 1/16 in. either way from the true dimension, considerable study was given to the bellmouth formwork. At various stages, consideration was given to building the bellmouth oversize and putting on a plaster finish to the exact close dimension. At another stage, for forming the bellmouth, wood was considered in several different forms. One of these was bending narrow strips of wood to the desired form and another was to build the form out of heavy laminated wood and then adz the form to shape.

It was finally decided to build the inner form in a vertical position out of metal lath and plaster. This form was constructed in one piece, heavily braced, and was tilted from a vertical position to a horizontal position. After the reinforcing steel for the walls of the bellmouth was in place, the exterior form was built. The floor of the bellmouth was poured first, together with the side walls up to the level of the test section floor, and the balance was poured in a later operation. The fillets in the entrance to the bellmouth, approximately 6 foot measured along the center line of the tunnel, were built of wood covered with metal lath and plaster fitted against the shoulders of the walls, floor and ceiling.

From the diffuser section through the four corners to the bellmouth, the tolerance permissible in the formwork was 5/16 in. from the required dimension. The great variety of changes in sections and changes in fillets presented a constant problem in building the formwork, particularly fore and aft of the fan, where the sections change from rectangular to full circular and back to rectangular again.

Seriousness of Fuel Situation

I must emphasize that the outlook for supplying New York and many other places with enough coal to keep warm during the fourth winter of the war is gloomier than during any previous winter of the war. I am convinced that the problems of production and distribution of the domestic coals normally used in this area will be more numerous and more difficult than ever before in the recent history of our country. I am sure that the workable solutions for these problems will be even fewer. Consequently, those at hand must be made more effective by your efforts, by mine, by the efforts of all concerned, especially by the all-out efforts of the domestic coal consumers themselves, a matter upon which I will dwell at some length a little later on.

"Now this blunt prediction of greatly increased difficulty in supplying domestic consumers in your area with sufficient coal next winter may seem dire, unduly pessimistic—you may be inclined to regard it as "scare propaganda" thrown out to induce some desired course of action on your part, or that of the consuming public perhaps. To anyone who may labor under such a misconception, let me say frankly and honestly that this prediction is based upon the only conclusions that I am able to draw from a careful weighing of all pertinent facts and a careful study of all trends bearing upon the fuel supply. So I make the prediction that next winter we are going to have the toughest time keeping people warm that we have experienced in recent years—believing sincerely that I am right and hoping that I am wrong.

"During the calendar year of 1943, 610,000,000 tons of bituminous coal were actually required. There is every indication that 620,000,000 tons of bituminous coal will be needed in 1944. Calculations indicated a deficit of 20,000,000 tons of bituminous coal, concentrating in the eastern fields, which could be met to a large degree by conservation, withdrawals from consumers' stockpiles and distribution measures. But just as in the case of anthracite, the recent rapid change of circumstances is threatening to nullify our bituminous coal production estimates and our estimated deficit must be increased sharply. —*From an address by C. J. Potter, Deputy Solid Fuels Administrator, before the New York State Retail Solid Fuel Merchants Association.*

Engineers' Opinions on Post War Fuels Unaffected by Current Shortages

INDICATIONS are that after the War the less deadly but nonetheless hard-fought Battle of the Fuels will begin where it left off two years ago, according to a survey made by HEATING AND VENTILATING of over 1300 consulting and architectural engineers, 67% of whom are now engaged in design and specification of post-war projects. Replies were received from approximately two hundred offices.

Twelve questions were asked, two of which concerned fuels, an analysis of the answers to which are covered in this article. Articles based on replies to other questions will appear in future issues.

The first of the two questions on fuels was: *Have the fuel shortages affected your plans for post-war buildings to the extent of changing your usual practices?*

To this question 81% of those answering the question replied with a flat "No" or with a very slightly modified negative answer, such as "Not materially." An additional 5% answered somewhat less positively but with the sense of the answer being No, so that essentially 86% of the offices reported their plans unaffected.

Of the other replies, 8½% gave a flat "Yes", 5½% a qualified affirmative answer.

The foregoing breakdown summarizes the opinions of the engineers surveyed but it does not quite tell the complete story. Among the comments which were modified by the phraseology of the reply were the following:

Negative Answers:

The present fuel shortage will be forgotten excepting that more efficient heating systems will be devised.
No, but controls and efficient equipment are easier to "sell" to clients.
No, up to now, but if shortages are continued we expect changes.
No, except that we are stressing the desirability of flexibility so that either solid or liquid fuel can be used.
Not mechanically, but we are urging more than ever use of building insulation.

Affirmative Answers:

More consideration being given to stokers than gas.
Yes, less oil burning jobs, more coal and sawdust (Northwest).
Tendency toward soft coal stokers has been accelerated.
Yes, we have changed from oil to coal.
On smaller jobs have reverted to coal from oil.
Shortages have upset our clients who are dubious of the integrity of Washington.
Yes, planning for coal exclusively, but we believe gas and oil will be available for residential work.

The second question was: *Do you look for increased use of stokers where formerly oil-burning equipment was specified?*

Judging from the replies to this question, the consulting engineers answering are not yet wholly convinced that stokers will increase in popularity. Forty-six percent do not look for an increased use of stokers following the war, 43% do look for such an increase, and the answers of over 10% were doubtful or unclassifiable. The complete tabulation summarizes as follows:

The 46% negative answers consisted of 35% who replied with a flat "No" and 11% qualified comments. Affirmative replies were made up of 30% flat "Yes", 13% modified.

Comments on this question were especially informative. As with the first question, but even more so, the question was not accurately answerable by a Yes or No, as revealed by the following selected comments:

Positive Answers:

Yes, but not necessarily to replace oil.
Yes, but not on account of oil shortage.
Yes, in place of gas burning equipment (Pittsburgh).
Yes, for industrial and commercial work.
Yes, also pulverized coal.
Only in industrial plants.
Yes, for industrial and commercial work.
Yes, in commercial buildings.
To a small extent.
Yes, in this territory stokers are and still will take the place of oil burners (Cleveland).
Temporarily and for a short period after the war only.
Yes, no oil burning equipment in this locality (Scranton, Pa.).
Yes, cheaper heat.
Very slight increase.
Yes, substantially.
Yes, for industrial and commercial work.

Negative Answers:

No, but probably increased use of pulverized coal.
More a change to gas.
Not in this section (Oregon).
Not in California.

No, around here there is plenty of natural gas (Los Angeles).
Not in this section (Louisiana).
Not in this part of the country (Oregon).
Only in special cases.
Not here as gas is available (New Orleans).
Believe conversion to oil burning equipment will be made as soon as possible.
Not in this area (Florida).

Doubtful or Unclassifiable Answers:

No, but yes in place of hand-fired jobs.
Not until we are assured that oil is out.
For some of our clients the answer would be yes, but others will convert from oil to coal the minute they are allowed to do so.
Not in residences but yes in commercial and institutional buildings.
Not if oil is available; if cost is competitive, oil will be preferred.
If fuel oil is available no great increase for stokers, if oil cannot be had, expect a sharp increase.
For new work no, for conversion, yes.
It will break about even.

What Was in the Woodpile

WHY should any properly designed and installed two-pipe vapor system, with adequate boiler capacity to supply the steam, fail to give satisfactory results and why, of all things, should the dining room be so cold that it was necessary to wear fur coats during a dinner party one evening and by the next morning be so hot that the wax candles were bent double in the candle sticks so that the two parts touched? And why wasn't that condition confined to the dining room, if it had to exist, instead of next manifesting its idiosyncrasies in the sewing room or in one of the bed-rooms?

To find the answers to these questions kept several people on the rack for about two weeks. There seemed to be neither rhyme nor reason to the whole affair. Within a few hours after a room had failed to heat at all it might become greatly overheated and some other room become cold; or, perhaps, the operation would be normal for a couple of days and then the symptoms appear in some part of the house theretofore immune. The house was located in one of the newer subdivisions, near the city limits and, no matter what happened, by the time anyone could get to the place, regardless of how prompt was the response to the call, the symptoms had either disappeared completely or had developed in some other location.

Traps were opened up and cleaned out, the air eliminators at the ends of the steam mains, where they dropped to the wet return, were examined, return lines taken apart, blown out and reassembled. Still the insane game of hide and seek went on and the solution was apparently as far in the future as ever.

Everybody concerned was fast approaching such a condition of mind that, if the place had burned down, it would have been a relief. However, the contrary structure failed to oblige the wishful thinkers in even that respect.

All possible evidence was sifted, time after time, but no logical explanation was forthcoming.

One morning, however, the writer happened to be in the boiler room when the attendant arrived to fire up. This attendant, who was said to have had some ten years of experience at such work, took care of several houses in the neighborhood and was responsible for the operating of their heating systems.

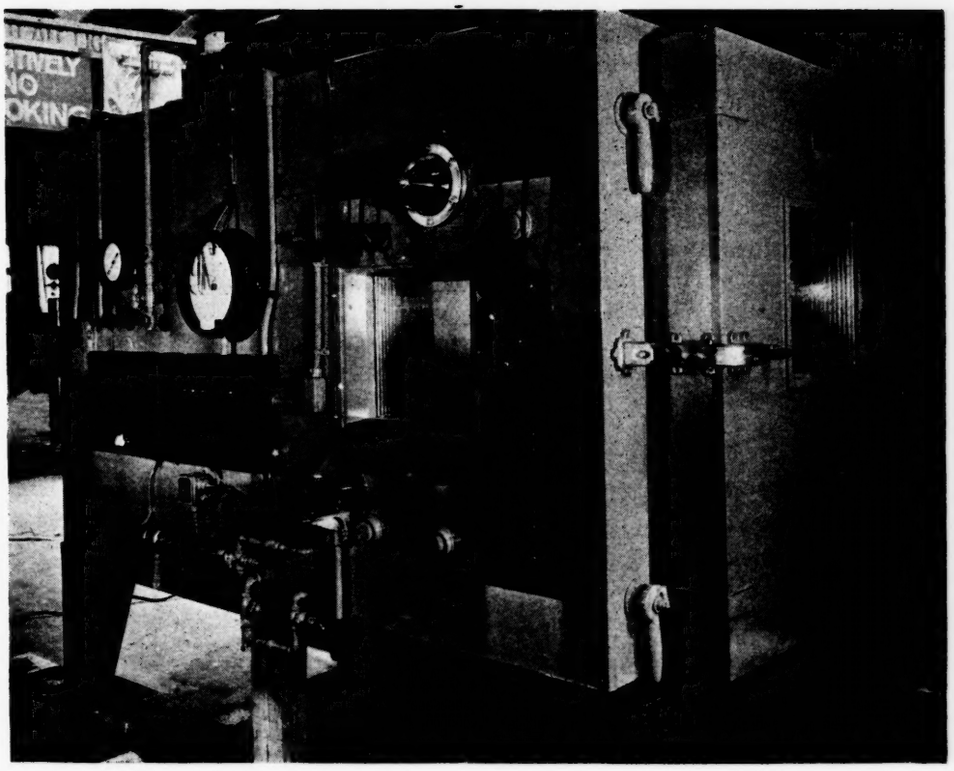
As he worked, the operations and the results were casually noted, as a matter of routine, without any particular interest, until, having cleaned the fire, and shaken it down well, the draft damper was opened up and left so, while the ashes were carried out—a matter of some ten or fifteen minutes, during which the pressure rose from a few ounces to several pounds. About that time, the proceedings assumed their true proportions and took their place as the most important event that had happened up to that time.

Why? Because the source of the trouble lay, not in either the design of the system, its installations or in any defective traps or other similar causes, but in the method of operation.

During the absence of the attendant, between firing times, the boiler pressure would gradually drop and, consequently the differential would decrease, the pressure at the ends of the branch mains drop and the air eliminators open. Under the stimulus of forcing, the rapidly rising steam pressure forced steam through the mains to the ends, closing the air eliminators before the steam filled all the risers and radiators and thus air binding the system in whatever portions might be slowest to heat up. That explained why there was no one part of the house or one room consistently affected, and also why, after an interval, the condition would right itself, only to appear elsewhere after a short time.

A little instruction to the attendant, applied with heartfelt emphasis, was apparently effective, for no further recurrence of the trouble was experienced.
—John J. Woolfenden, Engineering Staff, Smith, Hinchman & Grylls, Inc., Detroit.

Low temperature and controlled atmospheric pressure test chambers have had an important role in the design of new products, or the redesign of old ones.



Some of the cable connections required for a standard type stratosphere cabinet. A small motor drives the quick heat blower. Note the heavy wedge door clamp which sets up the initial door seal.

Design of Low Temperature Test Cabinets

F. CRAMPTON FROST and T. J. LOPICCOLO

MANY problems are involved in the design of a low temperature cabinet, as used by industry, with controlled internal atmosphere conditions. Early cabinets were refrigerated with dry ice, but with the use of mechanical refrigeration, the low temperature limit was brought down well below the zones reached with dry ice. Low temperature cabinets for testing, available today, represent a marvelous complex engineering development with precision control.

Stratosphere chambers are cabinets that can duplicate low temperature and rarified air conditions that aviators encounter at high altitudes. Cabinets are sometimes provided with heating and humidifying apparatus or special air treatment systems so that a wide variety of test conditions can be carried out in the one unit.

Such wide variety of control is important, particularly in airplane work. One must remember that an airplane, diving at 400 to 500 miles an hour, can duplicate in one to three minutes a climatic change equivalent to the transfer of the plane from the North Pole to the Equator. Such exceedingly rapid changes of temperature and air conditions caused many development engineers to wonder if the material used and the designs followed could take this severe treatment.

Almost everything physical, chemical and mechanical finds that the stratosphere is a strange world, and the resulting behavior in that sphere is likewise strange. For example, a spark which jumps the 1/16 in. gap in an automobile spark plug will jump a gap of 7 or 8 in. at an altitude of 60,000 ft. In the stratosphere, natural rubber becomes so brittle that it will shatter when dropped, ordinary oils congeal, and some plastics flow and disintegrate. One hundred cubic feet of air which weighs 7.5 lb at sea level now weighs but 1¼ lb. Simple electric generator carbon brushes, which have an almost indefinite life under ordinary conditions, disintegrate completely in a few hours at high altitudes. Gasoline cannot be ignited by a match at high altitudes.

As the result of tests under stratosphere conditions, and the work of research engineers, the quality and design of many products have been improved. Besides testing parts, it is also necessary to check on assembled units.

Cabinets for stratosphere work are available in almost any size and vary from small chests to large walk-in rooms. At present, they are chiefly used by manufacturers of aircraft, aircraft parts and equipment; parts development testing, assembly development testing and production testing. Small cabinets are usually suitable for parts development testing while the larger size cabinets or rooms are required for assembly or production testing.

Let us now examine the testing equipment that has had such an important role in the improvement of so many products.

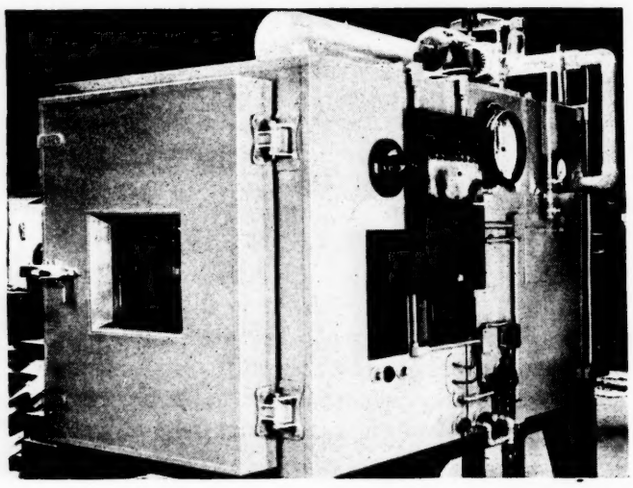
The stratosphere cabinet is not limited to any design, but it must withstand atmospheric pressure from the outside. Rectangular cabinets, at first thought impossible, have proven the best utilizer of space. They provide satisfactory window and door space, ease of equipment arrangement, design simplicity and frabication. With a knowledge of the product, the width, depth and height of the cabinet can be determined. If the cabinet size is up to 36 cu ft, a standard cabinet can be obtained. Larger sizes require a special job.

Overall interior size can be approximated by doubling the size of working space. About as much space is required by the evaporator, fan and other equipment as is needed by the user. The size of the room necessary for the chamber can be determined by allowing 12 in. for all wall thickness, insulation and structural reinforcement, another 12 in. for projecting valves, controls and appurtenances, and by considering the door swing and operating space around the cabinet. Depending upon the type tests to be conducted, allowances must be made for outside auxiliary equipment, and for an observation desk or test stand.

Common attachments include insulated observation windows, tuning shafts, insulated utility ports, high voltage high frequency connections, connector panels, coaxial cables and a wide variety of special devices adapted to vacuum seal construction. The attachments required depend upon the type tests to be conducted. However, to minimize thermal and vacuum leakage, the number of wall openings and connections should be limited.

Refrigeration

Low temperatures today are those of —40F and lower. They can be achieved by the use of specialized machines and intricate apparatus, or they can be attained by either mechanical or non-mechanical means.



High tension lead in, standard connector panel, and control switches for a stratosphere chamber.

Non-mechanical means require chemicals having heat of formation and/or heat of sublimation of a value to produce sub-zero temperatures.

Dry ice (solidified carbon dioxide) may be used as a refrigerant by immersing it in a liquid which does not freeze at temperatures approaching —110F. However, the lowest air temperature which can be easily produced with dry ice is about —80F, although by proper design and the use of small working space, —100F can be obtained. While dry ice refrigeration is low in initial investment as compared to mechanical refrigeration, its operation is not as flexible nor convenient.

Mechanical Refrigeration

A wide variety of systems is possible with mechanical refrigeration.

Single-stage refrigeration using F-12 refrigerant will economically produce temperatures down to —40F.

Two-stage (cascade or compound) refrigeration using F-12 refrigerant will economically secure temperatures between —40 to —70F.

Three-stage (cascade, compound, or straight compound) refrigeration using F-12 has been used for temperatures from —70 to —100F.

This breakdown holds only for the simplest conditions. When abnormally high wattage load dissipation is a requirement of performance, a two-stage system is used where a single stage is normally required. The added capacity is used to handle the extra heat load.

With the development and small scale production of F-22, it is possible to obtain temperatures of —55 to —60F with single stage; —60 to —90F with two-stage; —90 to —120F with three-stage. Unfortunately, F-22 is not on quantity production and the cost is relatively high — about three times the cost of F-12.

For a given boiling refrigerant temperature, in the evaporator, a lower pressure is required for F-12 than for F-22, so that lower temperatures are obtained with F-22. However the higher boiling pressure of F-22 has a disadvantage, for at room temperatures, the refrigerant exerts a much higher pressure and is more apt to leak out.

Low temperatures attained in the stratosphere chamber are limited not only by the materials used but also by the efficiency of the cooling medium and the machines used. A drop of one or two degrees below —70F means costly changes in machine selection due to refrigerating characteristics.

The multi-stage systems used can be either cascade or compound, or perhaps a combination of the two.

With the cascade system, there are individual and distinctly separate refrigerant circuits in each machine. The low-stage machine operates directly on the evaporator, and its discharge is condensed at low pressures by the next higher stage. The condensing operation becomes the evaporative load of this next system. The highest stage of compression

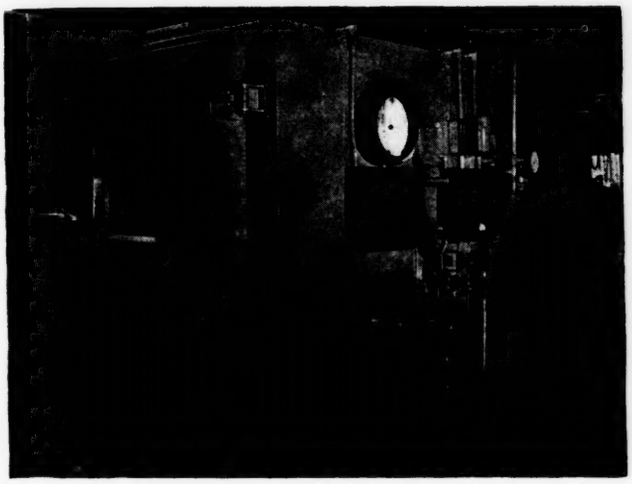
is condensed by either water or air. One advantage is that different refrigerant gases can be used in different stages. A disadvantage is the loss of about 15F temperature through the cascade condenser.

But one charge of refrigerant for all stages of compression is employed by the compound system. The discharge of the low-stage is the suction of the next stage. The interstages are properly cooled.

The cascade compound system is any combination of the two systems described.

Evaporators

Finned coil blast type evaporators are most common in the low temperature field.



Another design of a stratosphere test chamber.

Dry expansion evaporators feed refrigerant in at the top of a coil from where it flows down hill to the suction manifold. Distributors are necessary on the valve, and the valve requires sensitive regulation. However, oil problems are eliminated.

Flooded coil systems eliminate expansion valve troubles since uniform distribution can be obtained by the hydrostatic principle. There is the ever present possibility of coil becoming trapped in the evaporator unless overcome by design.

The use of cold plates has been carefully considered and although certain features are advantageous, some objections bear further study. Cold plate shelves carry away heat by conduction. Should a piece of equipment require no loss of heat to surrounding objects, other than all to the air (this being a duplication of actual field performance), then cold plates supporting such objects would give false test data.

Under equilibrium conditions of high altitude and low temperature, a large part of the holding load is formed by heat transmission and wattage dissipation from the equipment tested.

A definite and calculable weight of air per minute must be handled to carry away the Btu's dissipated. Since the density of air falls off with increasing altitude, a high volume of air must be moved. Power dissipation within the chamber, particularly at altitude, affects the overall design of the unit because not only are larger machines required, but also larger fans.

Dehumidification

Moisture as vapor migrates, without the aid of moving air, and collects on objects that are at or below the dewpoint of the air. The two general methods of dehumidifying are cooling and reheating, and air by-passing.

The cooling and reheating method involves the principle that by cooling, the wet and dry bulb temperatures have been reduced. By reheating, the dry bulb temperature is restored while the wet bulb remains low.

Moisture migration is employed by the air by-passing method. Air is by-passed around the cooling coil and the coil, being refrigerated, attracts water vapor, while the air is handled by the air mover. Temperature is controlled by electric heaters.

Low humidities are controlled in test chambers by keeping the dry bulb temperature constant and reducing the wet bulb temperature by refrigerating the cooling coil. The coil surface is maintained at a constant temperature to give a constant wet bulb reading.

Humidification

Since humidity is superheated steam, it can remain as a vapor only as long as the temperature of the air that carries it and the temperature of the objects with which it comes in contact are at a temperature higher than the dewpoint. As the dry bulb temperature increases and higher relative himidities are desired, more severe operating conditions result. The inner lining of the controlled air space must be within at least two degrees of the dry bulb temperature.

Air Movement

Efficient use of heating and cooling surfaces, and the need for uniform air conditions in the test space, govern the need for air circulation within the chamber. This is particularly true for holding dissipated heat loads simultaneously at low temperature and high altitude where rarified air offers little heat capacity with which to work.

Air motion is important at low temperature. In order to secure the exchange of heat from the equipment under test to the refrigeration system, a sufficient weight of air must be moved. Although air density increases slightly with a decrease in temperature, there is a material reduction of density when the air is rarified to high altitude conditions.

In other words, a large amount of air at low density must be handled at a high altitude to equal a lesser volume of air of high density which must be moved at sea level. This increase in air volume at altitudes calls for large fans and heavy fan motors, resulting in a high internal heat load generated by the fan. All these must be counterbalanced against

efficient coil operation, and efficient and economical machine sizes.

Evacuation of the chamber for altitude conditions is a direct and relatively simple matter. Factors governing the vacuum performance are the tightness of the chamber and the capacity and characteristics or efficiency of the vacuum pump.

Chamber leakage increases with the number of connections and openings, but it is offset by additional pump capacity. Normal evacuation to 50,000 feet in 15 to 30 minutes requires a pump no larger than 1.5 hp for a cabinet up to 36 cu ft capacity. A faster rate of evacuation and higher altitude calls for a rapid increase in pump size, and for more efficient type pumps where a high vacuum is required. Where possible, it is best to stay at 70,000 feet altitude or less. Since these cabinets are custom built, it is possible to obtain practically any condition desired by the customer.

Simplest and cheapest control of vacua is by manual adjustment of a relief valve, with the pump running continuously. Precise automatic control with recording is easily accomplished with the better type air-operated absolute pressure control activating a diaphragm air valve.

Heating

Due to the very low temperatures required to simulate stratosphere conditions, it is desirable to hold the high temperature specification to 180F or less. This helps reduce the existing extreme temperature range, especially because of the rapid temperature changes now demanded. These rapid changes have an effect on observation windows. The extreme temperature ranges introduce serious problems for insulation and gasket material. High temperatures within this range are readily obtained and accurately controlled.

Electric heaters are preferred in order to keep the entire cabinet electrically powered, and for ease of control. Multiple heaters of different capacity are furnished on any system to provide a choice of heating rate and close balance with load, for accuracy of control at any temperature.

Depending on temperature conditions, heating rate requirements, heat load, mass and temperature of test equipment, the total air heating requirement varies from about 5 kw on a 12 cu ft cabinet to 15 kw on a 300 cu ft room. Heaters are mounted in the air stream within the chamber and are served by wires led through the vacuum seal, and connected through necessary relays and controls.

Control

While the control and performance of all this equipment is most interesting and critical, it is also one of the most variable phases of the work. Control instruments can vary from a simple filled thermostat to a complex system of inter-related recording wet bulb temperature, dry bulb temperature, and vacuum controllers of a very sensitive type, and operating on a controlled program cycle.

A great deal is expected by some purchasers of an installation. They expect that by pushing a single button, they can start 25 hp of refrigerating machinery, 10 kw of electric air heaters, a 3 hp vacuum pump, a 3 kw immersion heater and a 1 hp fan, all in automatic operation through a series of intricate and rapid cycles. And in keeping with automatic operation, they expect all this without the least attention of an operator.

One must realize that the stratosphere chamber is a complex laboratory requiring and deserving the best care for best operation and maintenance.

Nevertheless, remarkably fine control of the various chamber functions, including automatic program or cycle control, can be obtained.

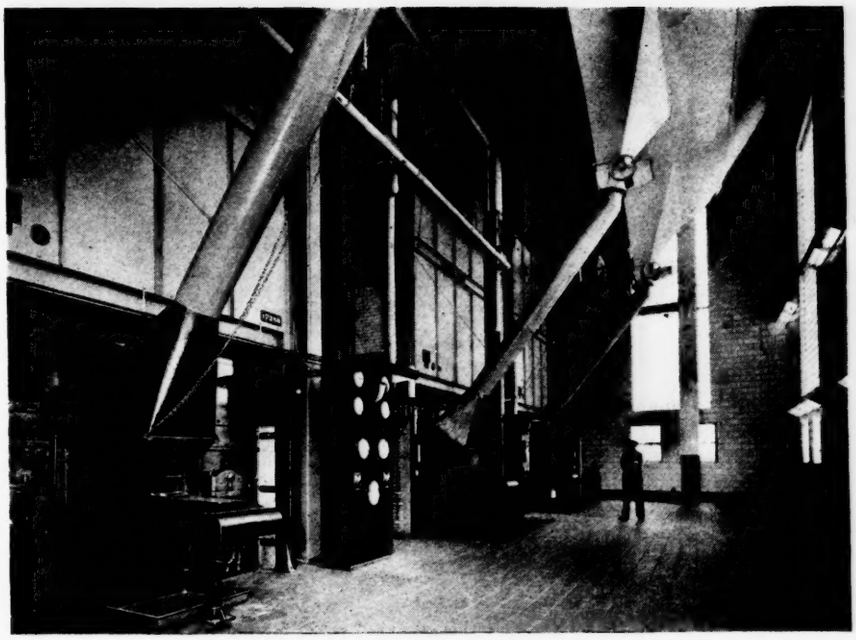
Get Your Free Copy of Fuel Conservation Manual

Coming off the press this month is a free fuel conservation manual, prepared by the Fuel Conservation Council for War. This book is the result of cocperative effort of the manufacturers of automatic controls who are members of the Council. It indicates the purpose and application of the various types of controls in relation to the big national fuel conservation job just ahead. Entirely non-promotional in nature, the manual treats its subject from the educational and practical approach, is a valuable book for anyone connected with the heating or maintenance of any building other than family homes.

According to M. W. Crew, chairman of the Council, there has long been a need for an impartial objective publication of this type. This need was recognized last year when the industry began to work with the Government bureaus concerned with the problem of conserving fuel. Consistent with the controls industry slogan "Fuel Conservation STARTS with Control", this book specifically indicates HOW controls are a dominant factor in fuel economy. It is part of the controls industry's broad program in support of the national fuel conservation effort.

The book is available upon request from the Fuel Conservation Council for War, 500 W. Oklahoma Avenue, Milwaukee 7, Wisconsin, or through any of the 26 controls manufacturers identified with the Council, or can be obtained by writing this publication.

The boiler room presents a surprising study in white. Coal lines are completely enclosed.



MYRON C. BEMAN
Member of Beman and Candee, Consulting Engineers, Rochester, N. Y.

New Power Plant Meets War Demands

HEATING, ventilating and conditioning of air in any plant enters into the production picture in a role as important as that of any fundamental element of fabrication. The source and production of power, artificial light, steam, air, hot water and other services largely used for manufactured articles, are of prime consideration.

In the Gleason Works, a war production plant at Rochester, N. Y., these services were given equal consideration with other elements for increased output. The result has been reliable, economical manufacturing with the best type of working conditions.

To make this plant flexible to meet war demands, a new power house was completed and a new electrical distribution system installed which will safeguard it from power failure. Labor and time saving devices were added which boosted the plant to a still higher state of efficiency.

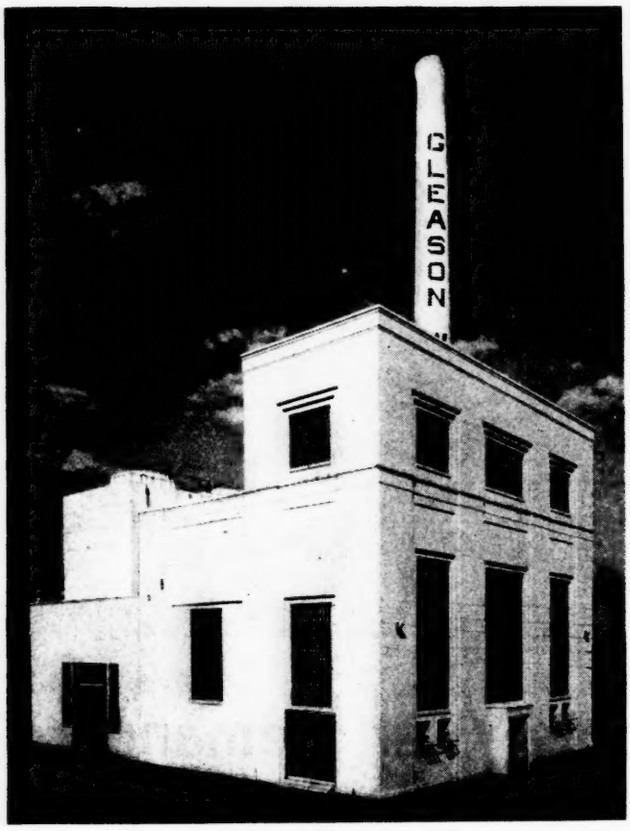
The former power plant, located near the center of the company's shop buildings, contained six 150 hp boilers with stokers using two chimneys, and furnishing 150 lb steam to Corliss engine-driven generators, compressed air from steam-driven air compressors, steam for heating and process work, and service hot water.

The Gleason Works, which has been turning out gears and gear-making machinery for many years, had realized for some time that their power house lacked the efficiency obtainable with more modern equipment. So when war demands called for additional buildings with further pull on the light, heat and power facilities, they lost no time in deciding on a complete new power house. Since it was necessary to keep the plant in operation 24 hours daily to meet shipping schedules, the old power plant had to be maintained until a new plant was completed. A site was selected at a point on the property adjoining the railroad. From the new power house, the output of steam, service water, air, etc., was carried through an underground tunnel to existing tunnels stemming from the old power house. The whole project was accomplished without the loss of an hour's time in the changeover from the old to the new source of supply.

The entire power house interior above the main floor is built of salt-glazed tile. The main floor is dark red Roman tile and all apparatus foundations are concrete extending to or through the tile floor. The building has glass brick for window areas, except for necessary monitor sash; doors are steel with glass panels. Fluorescent lighting is used throughout for general lighting and battery-fed 6-volt lighting, which automatically cuts in for emergency.

The plant burns bituminous nut and slack coal, but there is little evidence of fuel. It can be seen only at a few inspection points during its flow through the boiler plant. Coal is dumped from cars through a track grating to a hopper. A screw conveyor there delivers the coal to a bucket elevator. After it is elevated above the bunker over the power house, it is distributed by a scraper conveyor through controlled openings to any part of the bunker. The bunker itself is entirely sealed into the wall of the building and no dust or dirt from handling the coal reaches any part of the boiler room. A very modern vacuum cleaning system installed in the boiler room takes care of dust and dirt from any other source.

From the bottom of the bin, each boiler stoker receives coal in its hopper through a round 15-in. chute controlled by a dust-proof Seco chain operated rack and pinion valve. The stokers are steam-driven Detroit, underfeed type, continuous ash discharge, with



New power house, Gleason Works, Rochester, N. Y.

hollow air-cooled, moving grates. The 2¾ W Clarage stoker fans are placed under the rear of the boilers in the undercut section of the setting. Air from the fans is controlled by louver outlet dampers and Bailey air motors. They operate at 1150 rpm, furnish up to 11,000 cfm, and are driven by direct connected 10 hp splash proof motors placed on the right side of each fan and connected through a Rawson coupling.

Each fan is also driven by a direct-connected 16-in, 3-stage impulse Carlin turbine from the left side of fan through a second Rawson coupling. These couplings are arranged to engage only when driven forward and no change or alteration is necessary to put either drive into service.

The 175 ft by 7½ ft chimney is built of manganese radial brick to match the building exterior and is of sufficient size to carry a future additional boiler.

The ash discharge grate action is manually controlled from the boiler front to suit the load and type of clinker. Coal and air regulation are automatically controlled by Bailey Meter Co., adjustable coal, air and draft compressed air operated controls adjusted for the most economical operation throughout the boiler range. Bailey recording boiler meters with steam, air, feed water uptake and steam temperature pens are used for recording boiler operating results.

Ash discharged from stokers is dropped into a concrete, brick-lined hopper in the boiler foundation, one at each side of the boiler. The bottoms of these hoppers are at a steep angle and are closed with ceramic-lined, manually gear-operated gates which hold the ash and clinker in the hopper when closed, and allow this refuse to discharge to the enclosed grating of a United Conveyor Corp., "Nuveyor" steam actuated pneumatic ash disposal system. This carries the ash and clinker to a separator tank mounted on the top of a circular tile bin. When in operation, the steam jet producing the operating vacuum is under control of a time clock which turns off the jet periodically to allow the separator to dump ash and clinker into the bin by gravity. Ash and clinkers are handled in a dry state throughout the cycle as the steam jet is an assembly outside the path of ash travel. The jet discharges its steam into the breeching near its entrance to the stack. The bin is provided with discharge chutes with water sprinklers in the base which is well above truck height and the contents are thus carted to any desired point of disposal.

The usual coal and ash dust and dirt are entirely avoided in this plant and the cleanliness of the boiler room is equal to that obtained with the best gas or oil fired boiler installations.

There are three Class 30 Babcock & Wilcox 25,000 lb standard Stirling type boilers, with superheaters, operating at 250 lb and 100 degree superheat. Boilers are in brick setting with manganese face brick which matches the building brick, and are provided with Diamond Valv-in-Head Soot Blowers, Prismatic and Eye-Hye water gauges, steam gauges located in Bailey Control Board, stop and check and the blowoff, superheater and boiler safety valves, and other usual valves for operating the boilers.

A Cochrane continuous blowdown system in which the heat taken from the boiler by its operation is returned through exchanger to the incoming make-up water is provided. The rear of each boiler is undercut, and soot hoppers are provided under the last pass to collect the soot and fly ash which accumulate. Gates and connections to a branch vacuum line from the ash handling system allow these hoppers to be cleaned and the soot and ash de-

Ash disposal hoppers

posited in the ash bin. A similar arrangement is provided for the base of the stack.

Condensate from the turbo-generators, from heating system and drips, are returned to a Cochrane deaerating feed water heater together with auxiliary turbine steam, stoker cylinder steam, etc. Thus dissolved gases are eliminated and boiler, turbine and piping are kept free from corrosion. The water is reheated to 220F and in the 3000-gal tank below the heater, the feed water is stored and necessary make-up water automatically added by a float control valve. A complete water testing laboratory is maintained in a corner of the boiler room and feed-water treatment and blow down are governed by results of daily water tests.

Feed water is taken from the heater tank and is fed to the boilers by Allis-Chalmers 3 x 2-in., 2-stage, type M, 160 gpm centrifugal pumps operating at 3500 rpm. One pump is driven by a direct connected 50 hp 3500 rpm motor while the other pump is powered by a Coppus 20-in., 2-stage impulse turbine operating at 3,500 rpm. Either pump will supply all three boilers at full capacity.

Control of the feed water to the boilers is through a Copes thermostatic regulator and valve on each boiler. A continuous record is made of the CO_2 obtained by a Hays automatic recording combustion meter which with its filters, water-cooled condenser, automatic sampler and recorder gives results of combustion in the boiler furnace.

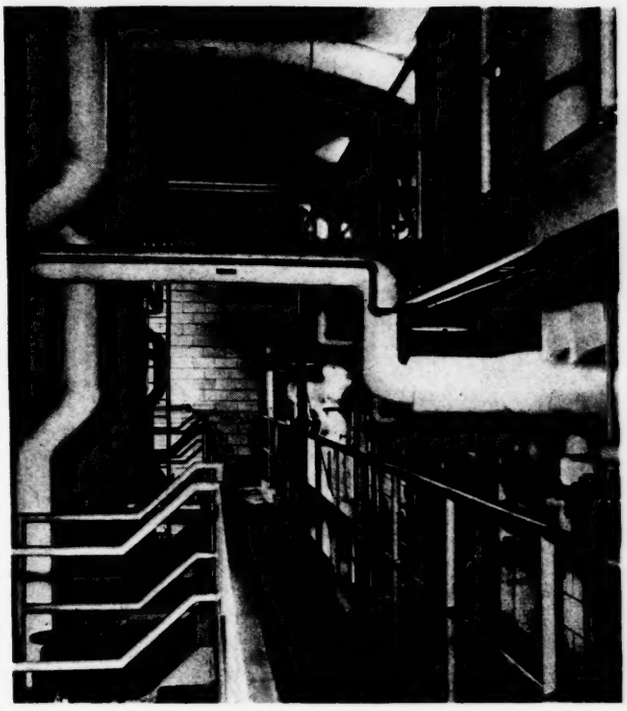
Turbines Installed

For both electrical and heating service, a 1,250 kva Worthington-Moore extraction type, condensing turbo-generator has been installed and all connections, foundations and auxiliaries provided for a second unit to be installed as soon as war conditions will allow.

The turbine, operating at 3,600 rpm, is direct-connected to a Crocker-Wheeler 1,250 kva, 4,330-volt, 60-cycle, 3-phase, 80% power factor generator. Steam for heating is extracted from the turbine between the high pressure and the condenser sections of the rotor by means of two double-seated, balancing valves automatically opened or closed in accordance with steam demand. This mechanism is inter-connected with high pressure inlet valves controlled by a Woodward speed governor, so that constant speed and extraction pressure is maintained. If more steam for heating is required than turbines can supply, due to the electric load or to weather conditions, the necessary supplementary heating steam is supplied by a pair of parallel Kieley-Mueller air operated reducing valves using direct boiler steam.

Steam for process work is furnished at reduced boiler pressure through reducing valves. All of the steam, water and air services are carried to the basement and through a 500-ft tunnel to shop distributing tunnels, as mentioned above.

The new electric distribution system was built and was installed throughout all buildings in connection



Rear of the boilers in the new power house

with electric supply from the power house. Three-phase, 60-cycle, 4,300-volt ac electric current is generated by the turbo-generators. This source can be supplemented and interchanged by connection to the Rochester Gas & Electric Co., 11,000-volt service through switchgear, transformer and voltage regulator. A total of 2,500 kva will be available by generation and a total of 3,000 kva is available through the service connection from the power company.

The electric current supply from turbo-generators and from the city electric company is put through separate dead front switchgear panels and is then carried through 6 underground, 3-wire cables to 7 ac unit sub-stations in shop buildings where current is distributed by means of bus duct to machines, lights, etc. Direct current is made by means of transformers and rectifiers at three of the ac substations. Dc is supplied for cranes, magnetic chucks, and testing.

System design will permit all of the load to be placed on either source of electric supply, or any portion of the load on either source. With this flexibility of operation, any desired amount of the power house steam production can be put into generation of electricity, to make efficient use of the steam as the quantity varies with the heating season, with day and night operation, etc. The amount of current purchased from the power company can be controlled to make efficient use of its rate schedule and demand charges. In the event of trouble with one source of supply, the other is available and plant shutdowns are avoided

The 3-phase, 4-wire secondary system provides two voltages on the same lines which can be arranged to furnish 120/208 volts. Voltage regulators control the current to the six plant cables.

Turbine and compressor room

For each turbine an Allis-Chalmers surface condenser of 1,820 sq ft surface, together with pumps and a 2-stage Croll-Reynolds air evactor, is provided to secure a minimum of 28½-in. vacuum for low water rate operation of the turbines.

The circulation water is handled for each condenser by a 10-in. Allis-Chalmers double suction type S pumping unit with direct-connected 40 hp motor. This pump elevates and receives cooled water from a 3-fan, induced draft, transite covered Marley cooling tower on the roof of the turbine room, which handles 4,140 gpm when cooling 15F with a 72F wet bulb.

The service hot water is provided by two 750-gallon hot water generators in power house basement. Water connections extend through the tunnel to the various showers, wash basins, and wash fountains with recirculation to generators by pump arrangement.

Compressed air for shop and foundry services is produced by a synchronous motor-driven Ingersoll-Rand horizontal, duplex double acting, crosshead type air compressor located in the turbine room. It is a 26-in. diameter x 16½-in. diameter by 18-in. pre-2-stage compressor with channel valves taking air from the turbine room roof and delivering up to 2,200 cfm at 100 lb. gauge. The 350 hp, 4,160-volt, General Electric type TS, self-starting synchronous motor is located between the crank shafts and turns at 200 rpm. The control is the 5-step clearance type, regulating down to 20% of capacity.

A smaller Ingersoll-Rand XRE-2 heavy duty duplex 12½-in. x 8-in. diameter x 8-in., double acting compressor and General Electric 100 hp, 220-volt, 450 rpm, self-starting synchronous motor providing 600 cfm has been installed for light air load periods. Both synchronous motors have motor generator exciter and automatic step starters.

This power plant has been in operation for more than a complete year and has proved throughout varying conditions that it has carried out the intent of the design, which was to make all possible savings while giving adequate electric, steam, air and hot water service for the manufacturing facilities and heating of the plant.

The design and supervision were by Beman and Candee, consulting engineers, Buffalo, N. Y.; the building was constructed by John B. Pike & Son, Rochester, N. Y., and the equipment installation and piping were done by Perdue and Company also of Rochester.

Underground Temperatures

Ground temperatures at less than 3 feet are affected by daily fluctuations in air temperature, but below that point this is not true, according to a study made by the Bureau of Mines and reported in its publication "Temperature of Natural Gas Pipe Lines and Seasonal Variations of Underground Temperatures," by W. M. Deaton and E. M. Frost, Jr. The study reported by the authors was made along a 22-in. natural gas line in Texas, New Mexico and Colorado.

It was found that at a depth of 3 feet a lag of 2 or 3 days in temperature response may be expected following an abrupt change in atmospheric temperature. At a depth of 6 feet or more, the ground temperature responds only to seasonal temperature variations or to extended periods of abnormal conditions.

The yearly temperature records showed that the highest temperatures at depths greater than 3 feet usually occur in September, whereas the lowest temperatures at these same depths usually occurred in March.

It was observed that frequently the temperature of the surface of the ground was considerably higher than that of the atmosphere. During the daylight hours when the sun is shining brightly the temperature of the unshaded surface of the ground may be 20F, 30F, or even 50F higher than the atmospheric temperature observed by a shaded thermometer. Thus the underground temperatures will be affected by the surface ground temperature more directly than by the atmospheric temperatures.

The kind of soil affects the rate of heat transfer through it and influences the rate of change of the underground temperatures; moisture in the soil also influences the rate of heat transfer. However, these factors were not known well enough to justify evaluation of these rates.

PRESENT
4" CROSS
4 C.B. CONN.
STRAINER
PRV 900
1½" 300#
NOTE P VALVES
BY PASS
2" CHECK VALVE
THERMOMETER
ED LINE
SEPARATOR

Heat Recovery from Diesel Engines

H. J. KINKADE

Fairbanks, Morse & Co., Chicago

Diesel engines, from all indications, will occupy an increasingly prominent position in the post-war period. Their present high engine efficiencies can be further increased by the complete recovery of the heat that is now removed by the lubricating oil and cooling water. This heat, now generally wasted, can be used to humidify or dehumidify air, for comfort heating and for producing refrigeration. This article describes how the present waste heat may be recovered and how it can be applied.

THE diesel engine is probably the best known efficient prime mover used to convert heat into mechanical power. Even this machine, however, wastes far more of the heat energy in the fuel than it transforms into power. Heat energy which is ordinarily wasted can be recovered and put to use. How this heat can be recovered and the uses to which the recovered heat can be put, are the objects of this article.

The growth of the diesel engine industry has been rapid, and is a tribute to the efficiency and adaptability of the engine. Table 1 gives approximate figures on the number of diesel engine horsepower installed in America for various years and it demonstrates the growth of diesel use.

TABLE 1. DIESEL HORSEPOWER BY YEARS

Year	Diesel Hp Installed
1920	130,000
1925	350,000
1930	410,000
1935	1,200,000
1940	3,500,000

The total diesel engine horsepower now in use in this country is about 20,000,000, divided approximately as to use, as follows:

Stationary power plants (industrial, public utility, municipal power plants, etc.)	37%
Mobile power units (tractors, earth moving machinery, etc.)	31%
Marine power units	19%
Transportation (railroad, trucks, buses, etc.)	13%

In most of these applications a part of the fuel energy converted into heat, instead of power by the engine, can be recovered for use. Industrial plants generating their own power with diesel engines are in the best position to recover and use the maximum amount of engine heat. In such a plant the heat demand will usually be so great that the entire amount of heat recoverable from the engine can be used.

Public utility and municipal plants usually have office space and storage buildings which can use hot water and space heating. If there are any industrial or commercial buildings near the power plant, heat can be sold to these establishments. Mobile power units can use but little if any of the engine heat.

On a boat using diesel engines for power, part of the heat from the engines can usually be used to supply hot water, and for space heating in winter. The same is true of diesel-powered railway trains.

It is possible to recover at least as much heat from a diesel engine as is converted to power. This would mean that there is a possible heat recovery of 2546 Btu per hp hour of diesel engine operation.

If we calculate that the heat from one-half of the 20,000,000 installed diesel horsepower can be used, this represents 50,920,000,000 Btu per hour of operation. To furnish an

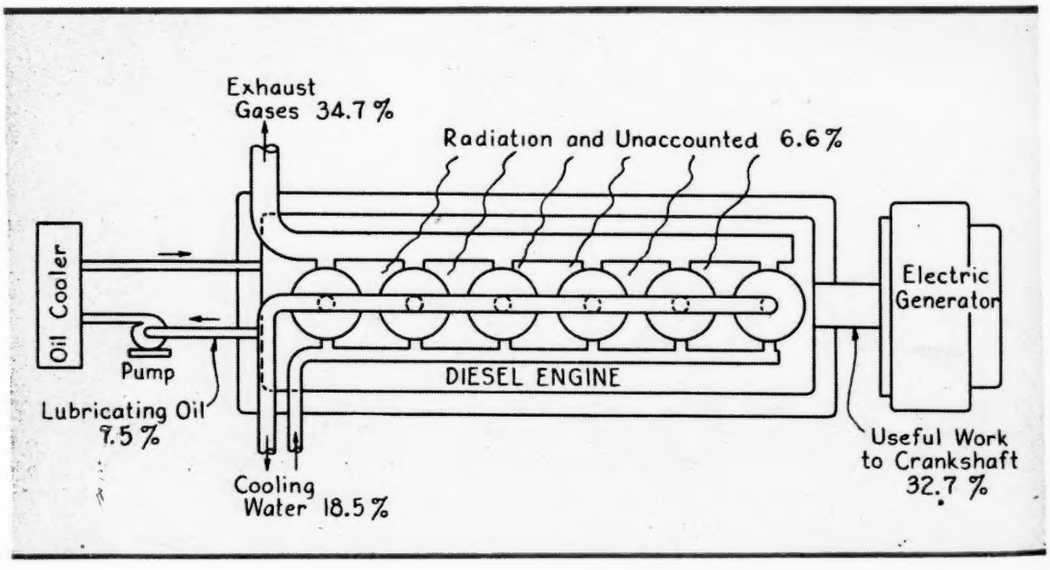


Fig. 1. Disposal of heat in fuel oil. Pump scavenging diesel engine with oil cooled pistons at full load. Two cycle engine.

equivalent amount of heat would require 3,270 tons of coal per hour, figuring 12,000 Btu per lb of coal burned at 65% efficiency. If the diesel engines operate 2,000 hours per year at full load, the heat which could be recovered is equal to 6,540,000 tons of coal per year.

Keen business competition requires that no preventable waste should be allowed, and no source of revenue neglected. *The large amount of diesel horsepower in use, and the small present use of heat recovery makes this a fertile field for economy in business operations.*

Amount of Recoverable Heat

Fig. 1 shows the final disposal of the total heat energy in the diesel engine fuel for one particular type of diesel engine, while Table 2 illustrates disposal balances for three different types of diesel engines.

Heat discarded into the cooling water and lubricating oil can be 100% recovered. Heat lost in radiation ordinarily cannot be recovered except as it may be useful to heat the engine room and adjacent spaces. Heat in exhaust gases may be partially recovered. The percentage of exhaust gas heat that can be put to good use depends upon the temperature of the exhaust gases and upon the equipment and method of heat recovery employed. The percentage of recoverable heat in the exhaust gases, when an efficient type of exhaust boiler is used as the heat transfer equipment, is shown in Table 3. This is for an engine at full load. When the engine is operating at less than full load, the amount of recoverable heat may be considerably less for the exhaust gas temperature is lower at part load than at full load, and also less heat is discarded into the exhaust.

TABLE 2.—HEAT BALANCE IN DIESEL ENGINES

Type of Diesel Engine	Heat Distribution	Btu per B.H.P. Hour				% of Heat Input			
	Load in % of Rated B.H.P.	25	50	75	100	25	50	75	100
Two-Cycle High Speed	Useful work	2,546	2,546	2,546	2,546	17.0	24.1	28.0	29.3
	Heat in cooling water	8,450	5,250	4,350	3,920	56.3	49.8	47.8	45.0
	Heat in exhaust gases	2,970	2,080	1,920	1,960	19.8	19.7	21.1	22.5
	Radiation and unaccounted	1,034	674	284	274	6.9	6.4	3.1	3.2
	Total heat input	15,000	10,550	9,150	8,700	100	100	100	100
Four-Cycle Crank Case Scavenging	Useful work	2,546	2,546	2,546	2,546	22.9	30.7	34.4	35.3
	Heat in cooling water	3,280	2,064	1,760	1,710	29.5	24.9	23.8	23.7
	Heat in exhaust gases	2,490	1,870	1,670	1,670	22.5	22.5	22.5	23.2
	Radiation and unaccounted	2,804	1,820	1,434	1,284	25.1	21.9	19.3	17.8
	Total heat input	11,120	8,300	7,410	7,210	100	100	100	100
Two-Cycle Pump Scavenging with Oil Cooled Pistons	Useful work	2,546	2,546	2,546	2,546	22.2	29.8	31.8	32.7
	Heat in cooling water	2,660	1,550	1,350	1,440	12.2	18.1	16.9	18.5
	Heat in lubricating oil	1,480	770	600	580	12.9	9.0	7.5	7.5
	Heat in exhaust gases	4,400	3,180	2,840	2,700	38.2	37.2	35.4	34.7
	Radiation and unaccounted	394	504	674	514	3.5	5.9	8.4	6.6
	Total heat input	11,480	8,550	8,010	7,780	100	100	100	100

As a practical illustration of the value of heat recovery, let us consider a particular engine installation.

An industral plant has installed a 120 hp four-cycle engine. The power load of the plant is practically constant at full engine load during the 8-hour working day, and a large amount of hot water is needed constantly for processing and for sanitary uses in the plant. Under such conditions the full amount of heat in the engine cooling water may be used to provide hot water to the plant. The heat thus recovered from the 120 hp engine is 470,000 Btu per hour. If the same amount of heat were produced by burning coal with a heat content of 12,000 Btu per lb at an efficiency of 65%, it would require 60 lb of coal per hour. If the coal cost $4.33 per ton, the saving would be $1 per eight-hour day.

Since it is always necessary to dispose of the heat in the engine cooling water there would be little if any additional equipment required to recover this heat. Consequently, the saving of $1 per day is clear profit. This would probably be sufficient to pay for the entire cost of the diesel engine over a 20- or 25-year life expectancy of the plant, or it would probably pay continuously the interest on the investment in the engine.

If an exhaust boiler were installed to recover part of the exhaust gas heat, an additional 161,000 Btu per hour would be recovered. This is equivalent to 20 lb of coal per hour, a saving of $0.33 per day or $100 per year. The saving would quickly pay for the exhaust boiler and return a profit thereafter.

TABLE 3.—PERCENT OF EXHAUST GAS HEAT RECOVERABLE FROM DIESEL ENGINE AT FULL LOAD.

Use	Four Cycle High Speed Eng.		2 Cycle Crank Case Scavenging		2 Cycle Pump Scavenging	
	Exhaust Temp.	% Heat Recovery	Exhaust Temp.	% Heat Recovery	Exhaust Temp.	% Heat Recovery
Heating water from 60 to 160F	720	76.7	390	59.2	450	65.0
Heating water from 160 to 180F	720	69.0	390	46.3	450	53.3
Generating steam at 5 lb gauge pressure	720	49.0	390	36.1	450	38.9

Note: Maximum back pressure at closed end of exhaust manifold should not exceed the amount recommended by engine manufacturer.

Uses of Recovered Heat

Heat recovered from a diesel engine may be used in numerous ways. There are 6 general uses:

(1) Heating water
(2) Heating air
(3) Generating steam
(4) Humidifying air
(5) Dehumidifying air
(6) Producing refrigeration.

One or more of the above uses of recovered heat will apply to practically every diesel engine installation.

Every ship and every factory needs hot water for various purposes. Likewise, every hotel, apartment, restaurant, ice plant, packing house, etc., must have hot water. For any of these purposes, heat from the diesel engine may be used.

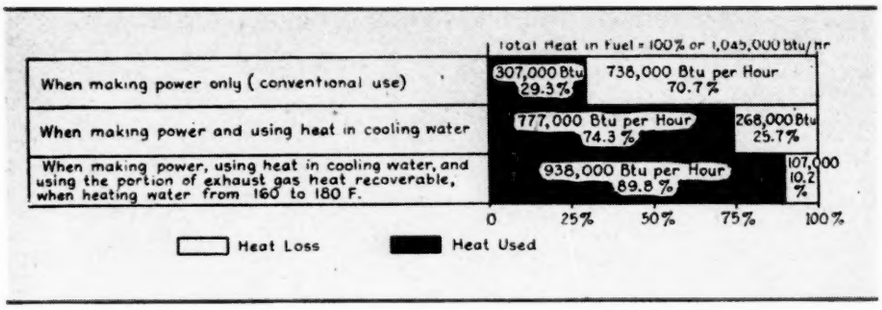

When making power only (conventional use)
When making power and using heat in cooling water
When making power, using heat in cooling water, and using the portion of exhaust gas heat recoverable, when heating water from 160 to 180 F.
307,000 Btu 29.3%
738,000 Btu per Hour 70.7%
777,000 Btu per Hour 74.3%
268,000 Btu 25.7%
938,000 Btu per Hour 89.8%
107,000 10.2%
0
25%
50%
75%
100%
Heat Loss
Heat Used

Fig. 2. Heat utilization for a 120 hp four cycle diesel engine at full load.

Heat from the engine cooling water must always be dissipated in some manner, and the equipment required to dissipate this heat costs money whether the heat is wasted or recovered. Engine cooling water may be used to heat city water to a temperature within 20 degrees of the jacket water temperature. A higher temperature may be attained by utilizing heat from the exhaust gases.

Hot air for industrial drying or heating is required in many manufacturing processes. Heat from the engine cooling water may be recovered for this purpose by pumping water through a finned coil or core over which air is blown. The temperature of this air leaving the heating coil may be from 90 to 140F depending upon the temperature of the water leaving the engine, and upon the design of the heat transfer surface as to thickness of the coil and air velocity. If higher air temperatures are required, the air may be passed through an air heater using exhaust gases as a heat source. Part of the heat in the exhaust gas may

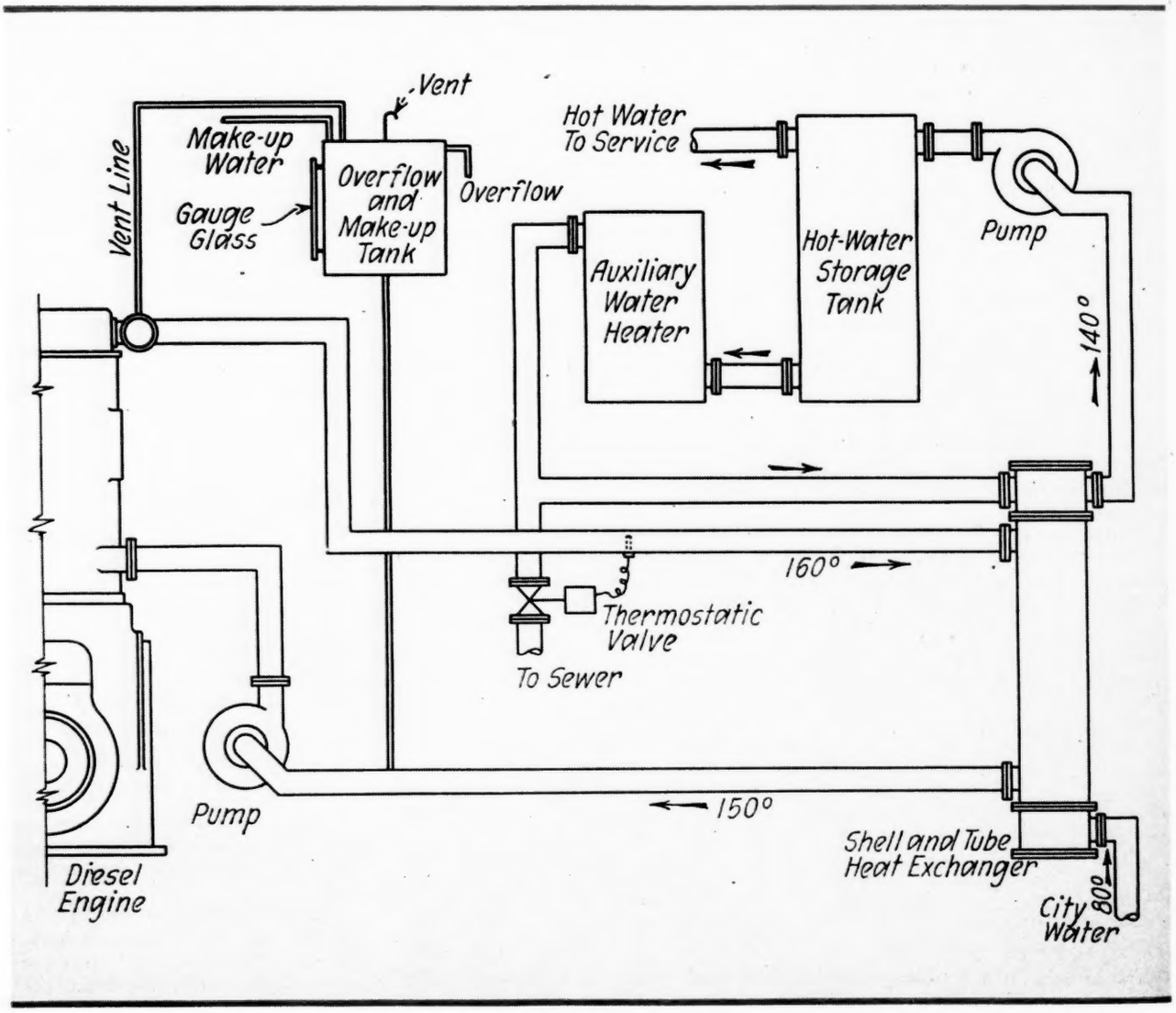


Fig. 3. Water heating system using the cooling water from a diesel engine as the heat source.

be recovered in this way, or by heating water which in turn is used to heat air. For space heating, the hot water may be pumped through conventional cast iron radiators or through coils of unit heaters or through central station type air heating units.

Heat from the exhaust gases can be used to generate low pressure steam for heating purposes or for industrial use. The higher exhaust gas temperature of four-cycle engines will give better results in steam generation than the lower temperature gas from a two-cycle engine.

Where it is desirable to add humidity as well as heat to the air, water may be sprayed over the coils through which the hot water passes. An evaporative cooler having continuous recirculation of the spray water can also be used for this purpose.

Where silica-gel is used to adsorb humidity from air, the heat from a diesel engine may be used to reactivate the saturated silica-gel.

To produce refrigeration with the heat from a diesel engine, the hot exhaust gases can be used to make the steam used in the generator of an ammonia absorption system.

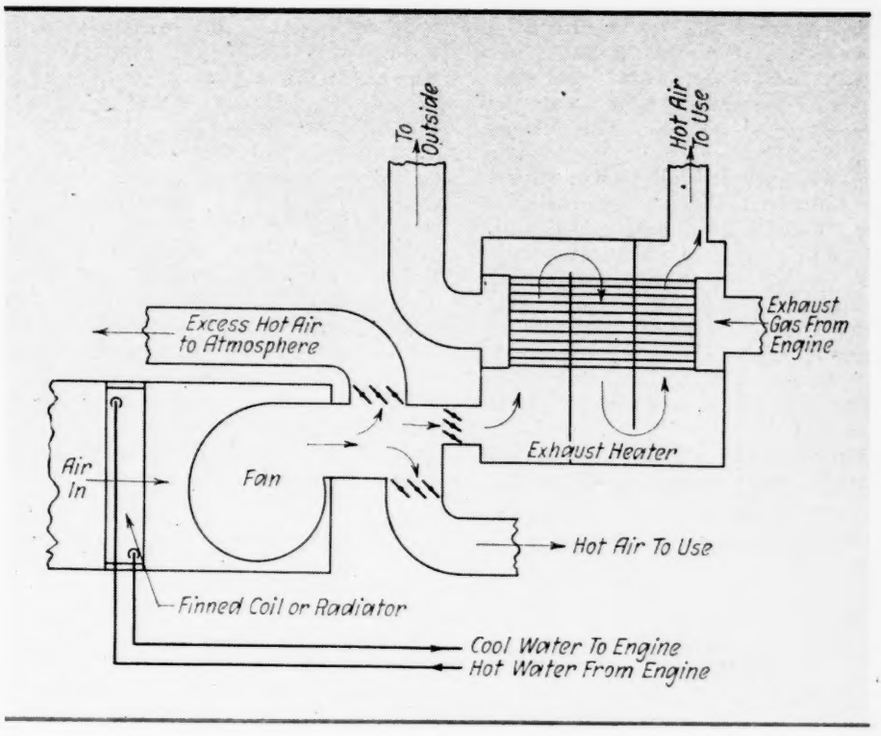


Fig. 4. Heating air with heat from engine cooling water and exhaust gases.

Methods of Heat Recovery

When considering any system to recover the waste heat from a diesel engine, the first thing to remember is that the engine must be adequately cooled under the worst conditions of heavy load and summer temperature. Heat recovery is of secondary importance to proper engine cooling, and must not be allowed to interfere with proper cooling.

It must also be remembered that the heat which can be recovered from an engine, or engines, will vary with the load. Engines may be considered as the primary source of heat only when the greatest demand for heat is less than can be recovered from the engines at the lowest load to be carried. This is the usual case in a public utility or municipal power generating plant. In such a plant there are usually several engines, and one or more engines are always in operation. The demand for heat is usually confined to heating the power house with its adjacent offices and storage buildings, and to supplying hot water to these same buildings.

In an industrial plant or a commercial building, however, the peak demand for heat will usually exceed the amount which can be recovered from the diesel engines at low load. This means that there must be another primary source of heat, and that the heat recovered from the engines must be considered as auxiliary heat. In an industrial plant the diesel engine will often operate at fairly constant load during the working day. However, another source of heat must usually be installed to do the heating job at night and over week-ends. The same thing is true of a diesel propulsion engine on a boat. When the boat is tied up at the dock the engines are not in operation, and heat must be supplied from some other source.

To use the heat from a diesel engine in the most efficient way, it is desirable that it be used for a heating load which is continuous throughout the year, and which will use the heat at a comparatively low temperature. Probably the most efficient use would be to heat cold water to a higher temperature where a great amount of hot water is needed all the time for industrial or sanitary purposes.

The largest source of heat from a diesel engine is the cooling water. This is also the heat which requires the least expenditure for recovery equipment. It is possible that equipment needed to recover this heat might cost less than the equipment required to throw it away, although this is not the usual case. The second most desirable source of engine heat is the exhaust gases, and the least desirable is the lubricating oil.

A method of recovering the heat in engine cooling water and using it to heat a supply of cold water to a high temperature is shown in Fig. 3.

The heat exchanger must be of ample size to dissipate all the heat in the engine jacket water at full engine load. This must be calculated with the cold water entering at the highest prevailing summer temperature. The engine should be protected from too high water temperature by a thermostatic valve which will waste some of the hot water, if necessary, and allow sufficient cold water to enter the heat exchanger to maintain the proper jacket water temperature. An exhaust boiler could be placed in series with the heat exchanger and auxiliary boiler, if the calculated demand for hot water is greater than can be supplied by the cooling water of the engine.

Where hot air is required for industrial drying or for heating purposes, the heat from engine cooling water and a part of the heat from

exhaust gases may be recovered in a system such as shown in Fig. 4.

The radiator or finned coil must be large enough to adequately cool the engine at full load with the hottest air of summer. If more heat is needed than the engine can supply, an additional coil can be placed in the air stream and supplied with hot water or steam from another source.

A completely automatic system for cooling the engine jacket water, recovering the heat, heating air, humidifying the air, diverting the hot air as needed, and supplying extra heat when required is shown in Fig. 5.

The engine water cooling coil must be large enough to adequately cool the engine at full load with the hottest air of summer. The three-way thermostatic valve maintains the engine cooling water at the proper temperature by by-passing part of the water around the cooling coil if its temperature tends to become too low. The thermostat T_1 controls the damper motor *DM* to maintain the proper temperature in the heated space as long as sufficient heat is supplied to the coils of the unit. Thermostat T_2 (set somewhat below T_1) controls the valve TV_2 to admit the heating fluid to the auxiliary coil when the main coil is not delivering enough heat. The humidistat *H* controls the relative humidity of the air in heated space by opening or closing the solenoid valve *SV*, which admits water to the sprays.

A simpler system employing unit heaters is shown in Fig. 6. No auxiliary heat is supplied in this case. The room temperature is controlled by the room thermostat *RT* which operates the damper motors *DM* to cause the hot air either to be thrown outdoors or returned to the room. The temperature of the engine cooling water is controlled by the thermostats *T* which turn the unit heater fan motors on and off.

Although only a part of the heat in the exhaust gases can be recovered in generating low pressure steam, and none of the heat in the

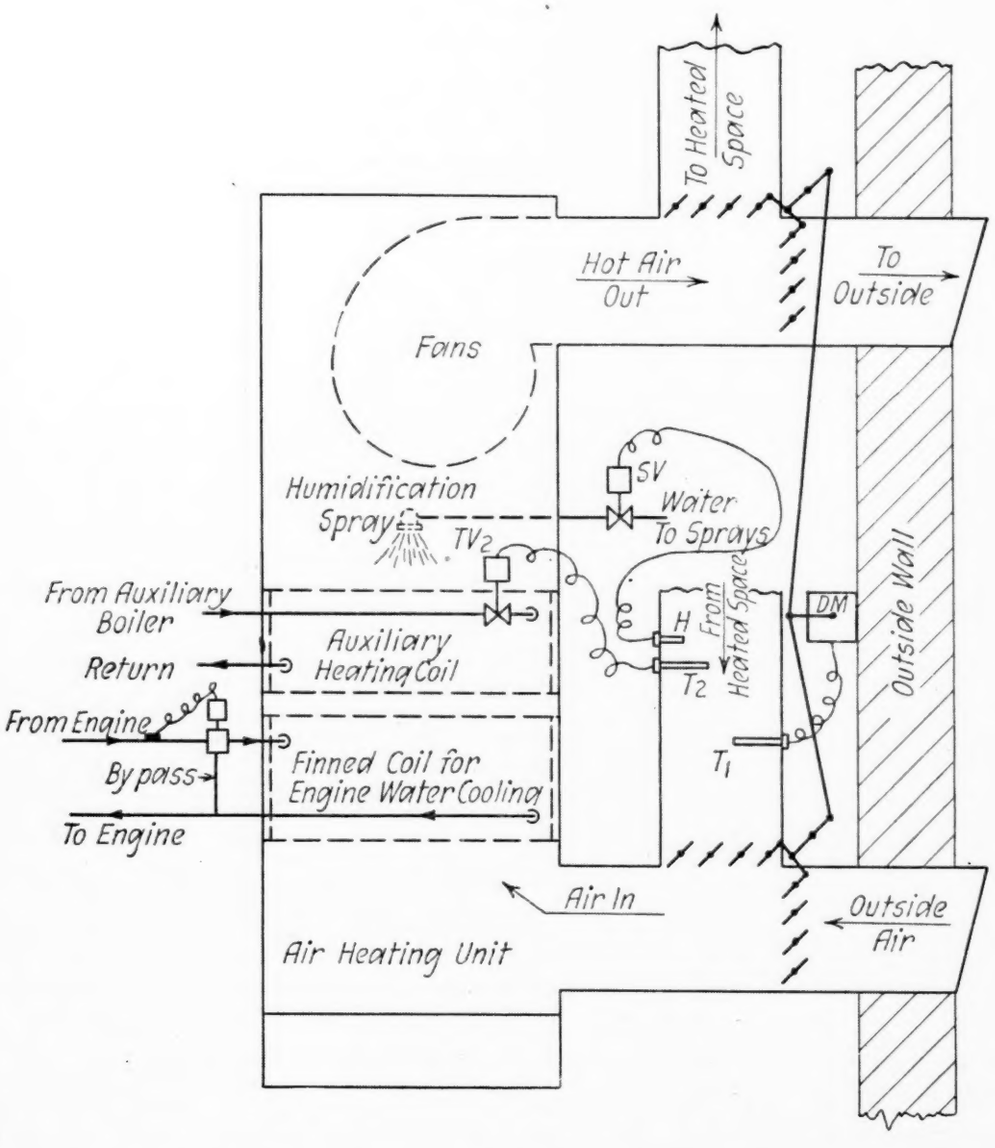


Fig. 5. Automatically controlled water cooling and air heating system.

TV, and TV, — thermostatic valves
SV — solenoid valve
DM — Damper motor
T, and T, — thermostats
H humidistat

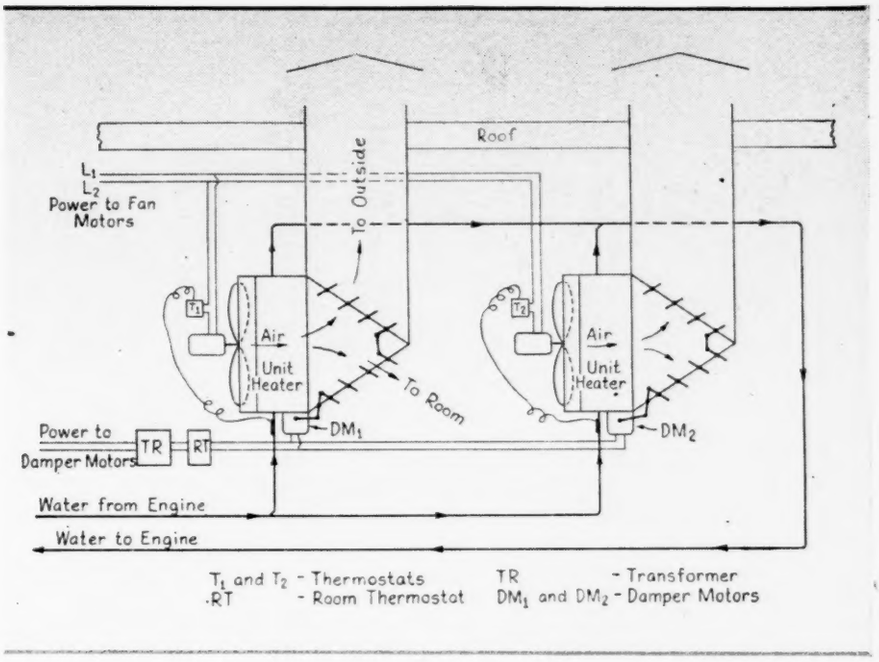


Fig. 6. Automatically controlled unit heaters for water cooling and air heating.

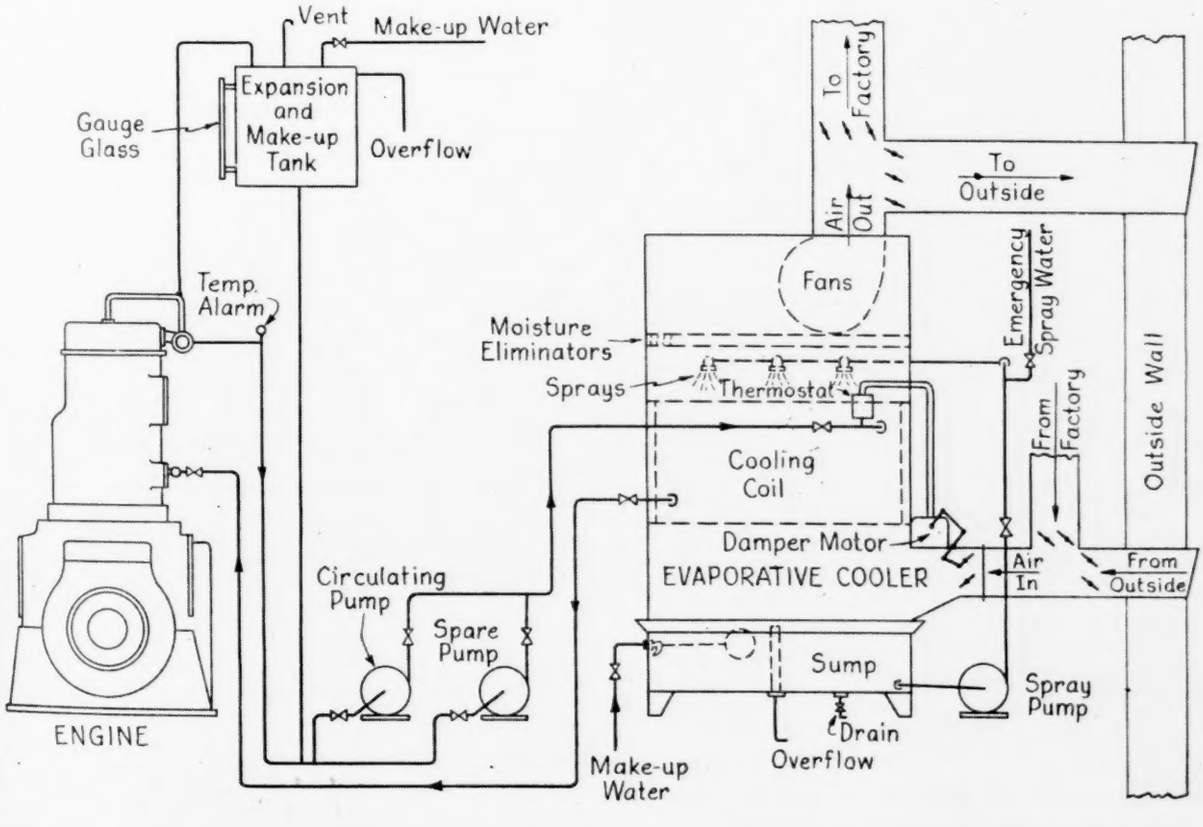
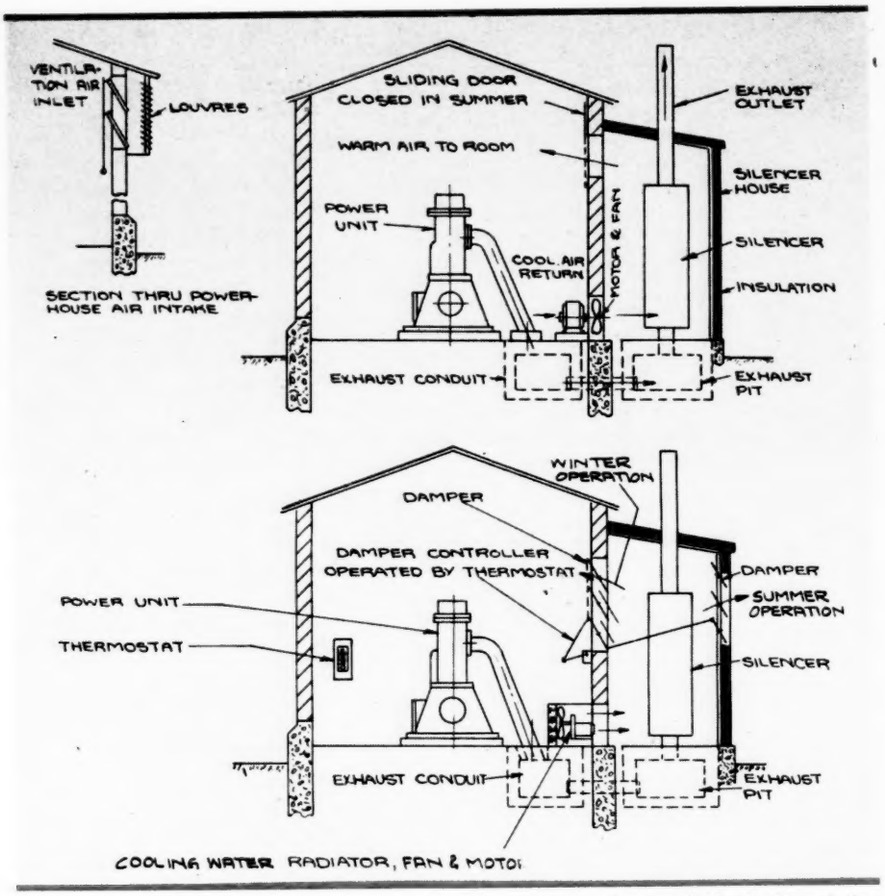


Fig. 7. Evaporative cooler cooling engine jacket water, and supplying humidity for manufacturing processes.



Courtesy, Fairbanks, Morse & Co.

Fig. 8. Upper, heating of engine room from the exhaust. Lower, heating of engine room from exhaust and radiator.

engine cooling water can be used for steam generation, the amount of heat so recovered will amount from 8.5 to 13.5% of the total heat in the fuel oil at full load. An exhaust boiler is needed to generate steam from the exhaust gases. This boiler should be of a type which will not be injured by running it dry at times when steam is not required.

Where a great amount of heat and humidity is necessary for industrial processes such as in a textile mill, an evaporative cooler may be used to cool the engine jacket water and to discharge the hot moist air into the factory to supplement the heating and humidifying system regularly used. Such an evaporative cooler is shown in Fig. 7.

The chief practical uses of waste heat from a diesel engine have been discussed. There are, however, other uses for this waste heat.

In a reverse cycle refrigeration system used for cooling a building in summer and heating it in winter, the winter load is almost always so much greater than the summer load that the size of the equipment must be based upon the winter load*. Using a diesel engine to drive the refrigeration compressor of such a heat pump system not only provides the lowest possible power cost, but also allows a reduction in the size of the compressor, since the heat from the engine cooling water and exhaust may be added to the heat of condensation of the refrigerant to make a very considerable addition to the heating capacity of the system.

Basing our calculations upon the use of a 150 hp, two-cycle crank-case scavenging engine directly connected to a refrigeration compressor, an analysis of the expected performance (Table 2) reveals the following:

*An explanation of this reverse cycle can be found in The Heat Pump, the first of the series of Blueprint of Post-War Realities, in the January, 1944, issue of HEATING AND VENTILATING.

Heat in fuel oil to produce 150 hp
= 150 x 7210 = 1,081,000 Btu/hr.

Heat converted to power
= 150 x 2546 = 381,000 Btu/hr.

Heat in engine cooling water
= 150 x 1710 = 256,500 Btu/hr.

Heat in exhaust gases
= 150 x 1670 = 250,500 Btu/hr.

Assuming that 1.25 hp is required to produce one ton of refrigeration, and that one ton of refrigeration will deliver 15,000 Btu per hour of usable heat to the condenser, the amount of heat which can be pumped from the low temperature of the evaporator heat source to the high temperature of the condenser by the 150 hp engine is:

$$\frac{150}{1.25} \times 15{,}000 = 1{,}800{,}000 \text{ Btu/hr}$$

The total amount of heat which can be delivered in usable form by the engine and compressor may be summed up as follows:

Heat pumped by refrigeration system
1,800,000 Btu/hr.

Heat recovered from engine cooling water
256,000 Btu/hr.

Heat recovered from exhaust
(50% of 250,000)
125,000 Btu/hr.

2,181,000 Btu/hr.

Heat recovered from the engine adds 381,000 Btu per hr or 21% to the 1,800,000 Btu per hr pumped by the compressor.

The total usable heat delivered by the system is 2,181,000 Btu per hour, or 202% of the 1,081,000 Btu per hour in the fuel oil consumed.

The above analysis has neglected the power required to operate the necessary pumps, fans, and other auxiliary equipment required for such a system of heat use, and has assumed the engine operating at full load. It is apparent, however, that the operation of such a system under actual conditions would give economies justifying greater consideration than has heretofore been given to it.

The final conclusion from this discussion is that an economic crime is committed when heat from a diesel engine is thrown away, if any possible use exists for this heat. Actually, it costs money for the cooling equipment required to throw away the heat from the engine cooling water. Any equipment required to recover this heat will quickly pay for itself. The high economy of the diesel engine as a prime mover can be further increased by using the heat generated in engine operation

Fig. 9. An exterior view of the new plant.

Installation in a Manufacturing Plant

How heat recovery from diesels is obtained in a modern industrial structure

A FEW miles south of St. Joseph, Mich., on highway No. 12, is located the new plant of Nylen Products Co. This plant is a modern structure of brick and glass blocks, and in peace time is devoted to the manufacture of pistons for refrigeration compressors and gasoline engines, machine tools, and various other products requiring accurate machine work and close tolerances.

Electricity used to furnish light and power for the plant and offices is generated in their own power house. In this power house are two diesel engines, with a third engine now being installed. One of the present engines is a 120 hp and the other a 225 hp. Both are two-cycle, crankcase scavenging engines, built by Fairbanks, Morse & Co. The third engine is another 225 hp of the same make and type.

The main machine shop is a building 60 ft by 200 ft with a calculated heat loss of 1,616,000 Btu per hour based upon 60F room temperature and —10F outside temperature. About 160 kw of the power generated in the engine room is used in this machine shop for lights and power. This power consumption generates an amount of heat calculated at 547,000 Btu per hour so that the net heating load is 1,069,000 Btu per hour.

The amount of heat discarded by the two engines into the jacket water at full load is 643,000 Btu per hour. The engines operate twenty-four hours per day at very near full load so that this amount of heat is always available. From the heat load calculations it will be seen that this will supply all the heat necessary in the shop when outside temperatures are 8.5F or above. At this temperature the total heat load is 1,188,000 Btu per hour. Of this amount 547,000 Btu per hour is released in the shop by the lights and motors leaving 641,000 Btu per hour to be supplied from the engine water.

The engine manufacturer recommends a water temperature of 160F leaving the engines. To cool the engine jacket water and to supply the heat to the shop eight unit heaters were installed having a combined capacity of 740,000 Btu per hour with 160F water and 100F air entering the unit heaters and a water circulation of 175 gpm total. The unit heaters, therefore, have more than sufficient capacity to cool the engines in summer. The capacity of the unit heaters in winter with 175 gpm of water entering at 160F, and with air entering at 60F is 1,233,000 Btu per hour. This is more than sufficient to supply all the heat needed by the shop.

An oil-fired, hot water boiler was installed to add more heat to the engine water in the coldest weather. This boiler is needed only when the outside temperature is below 8F, so that it is actually in operation very little of the time.

Unit heaters in this plant draw air from the shop space without any inlet ducts. The hot air may be discharged back into the shop or through duct work to the outside of the building. In summer this acts as an admirable ventilating system which discharges the hot shop air and brings in a large volume of fresh cool air to cool and ventilate the shop. The amount of air handled by the eight unit heaters totals about 32,000 cfm, or about one complete air change every ten minutes.

Each unit heater has louvre dampers operated by a damper motor and controlled by a room thermostat. This system diverts the hot air outdoors, or back into the room, as required by the room temperature. The system is similar to that shown in Fig. 6 except that each unit heater has its own room thermostat. The unit heaters are arranged in two groups of four, and all four heaters in each group discharge into a common duct leading outside.

No record has been kept of the amount of fuel consumed by the auxiliary oil fired boiler, but it is calculated that to heat the shop during one season would have required about 33,000 gallons of oil, and that the boiler has actually used about 2,000 gallons of oil during one heating season.

This is a saving of 31,000 gallons; which would cost $1,550 at 5c per gallon.

The cost of the heat recovery equipment, plus its installation was

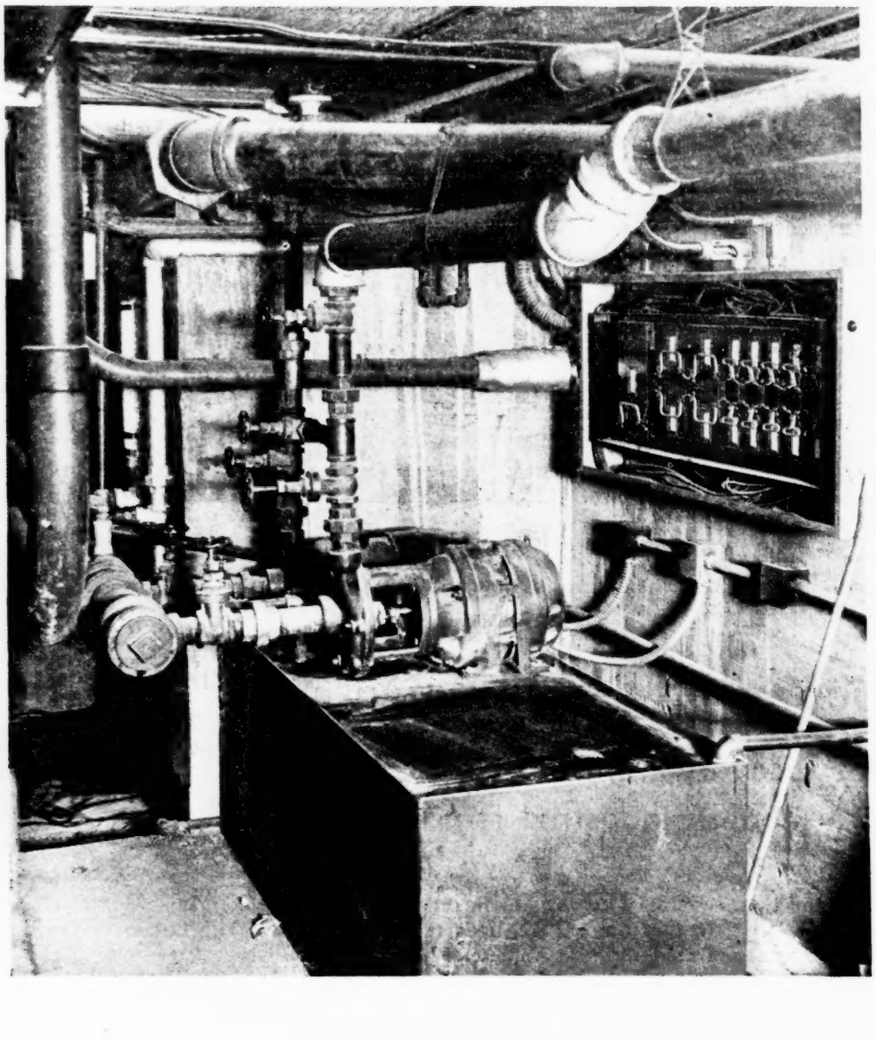


Fig. 10. Circulating pumps for
unit heaters.

Fig. 11. Engine room with the
engines now in operation in the fo
ground, and in the background
new unit not in operation.

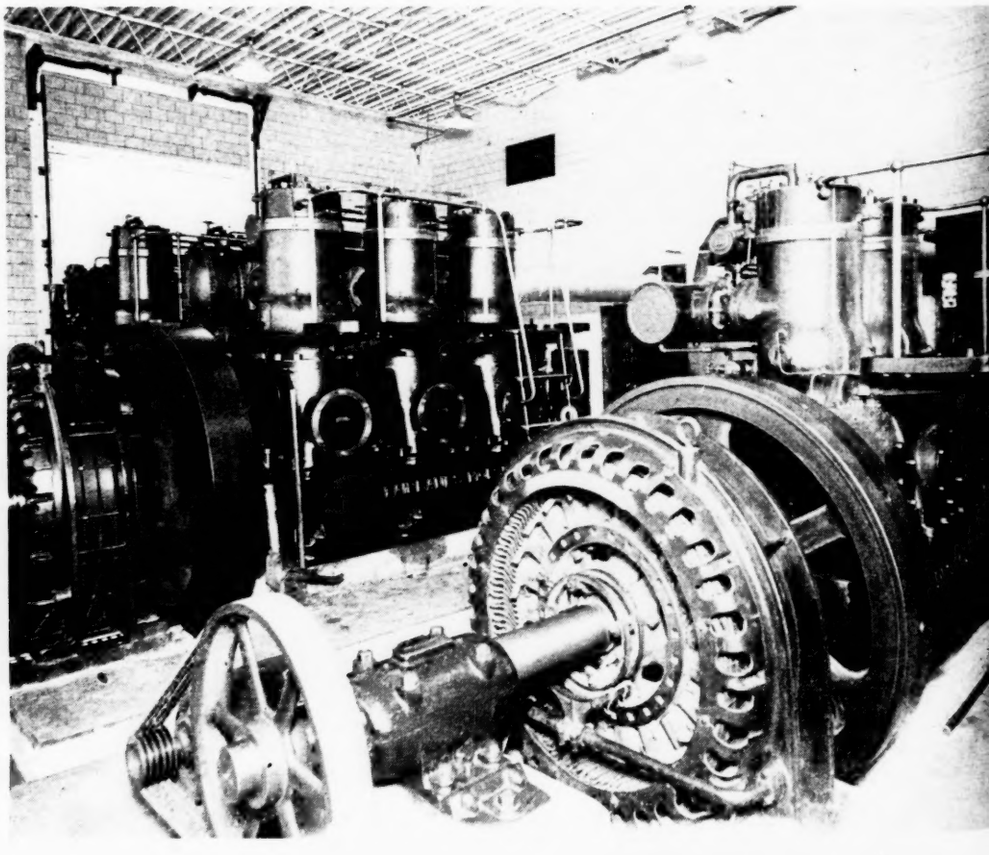


Fig. 12. **Auxiliary oil fired boiler.**

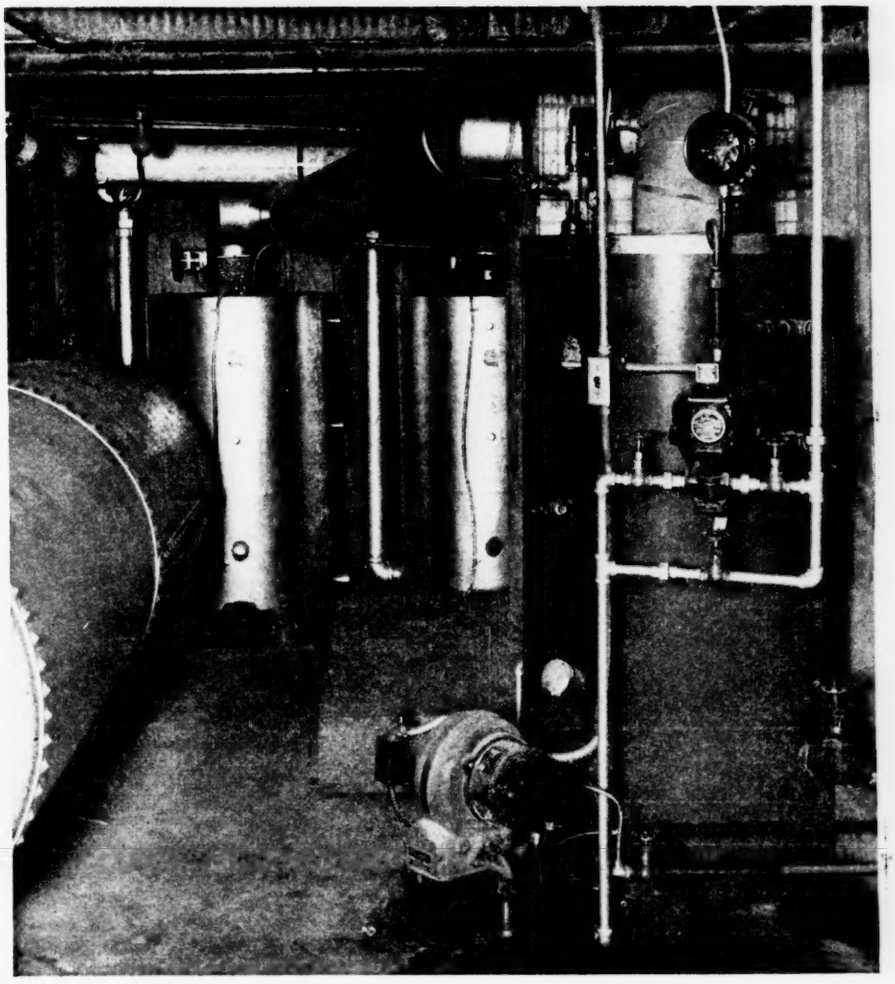
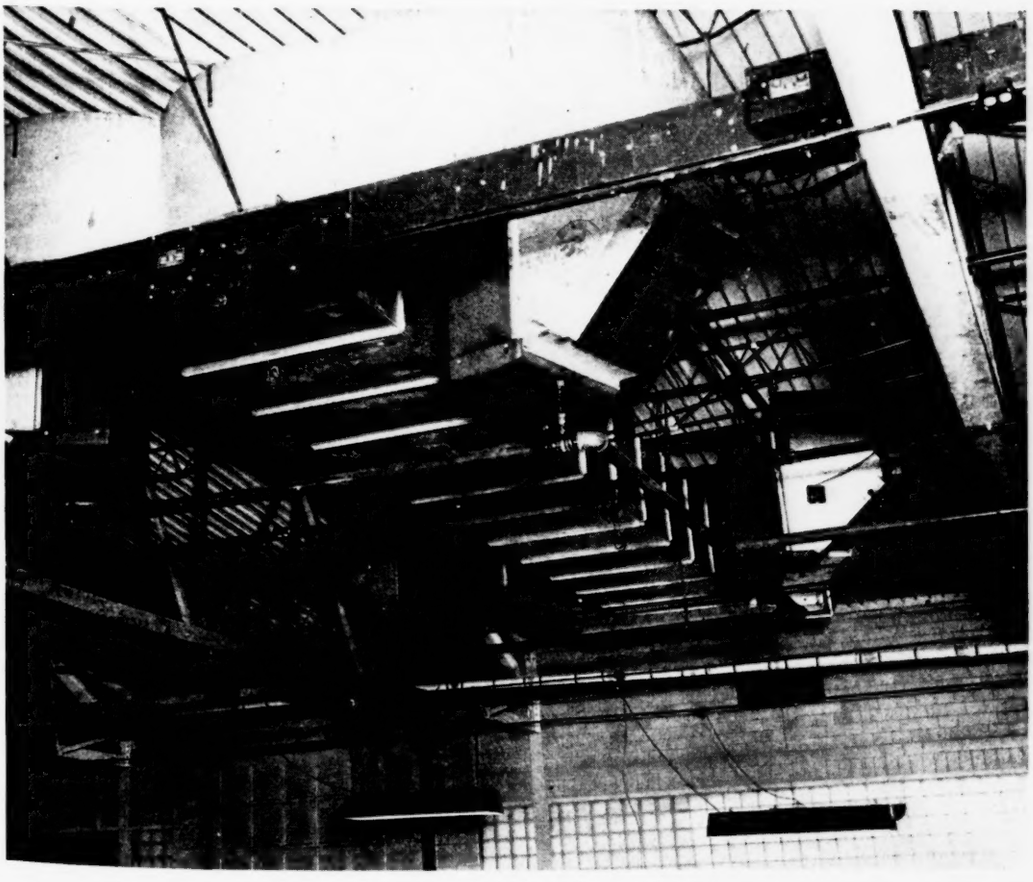


Fig. 13. Group of unit heaters. The circulating pumps are shown in Fig. 10.



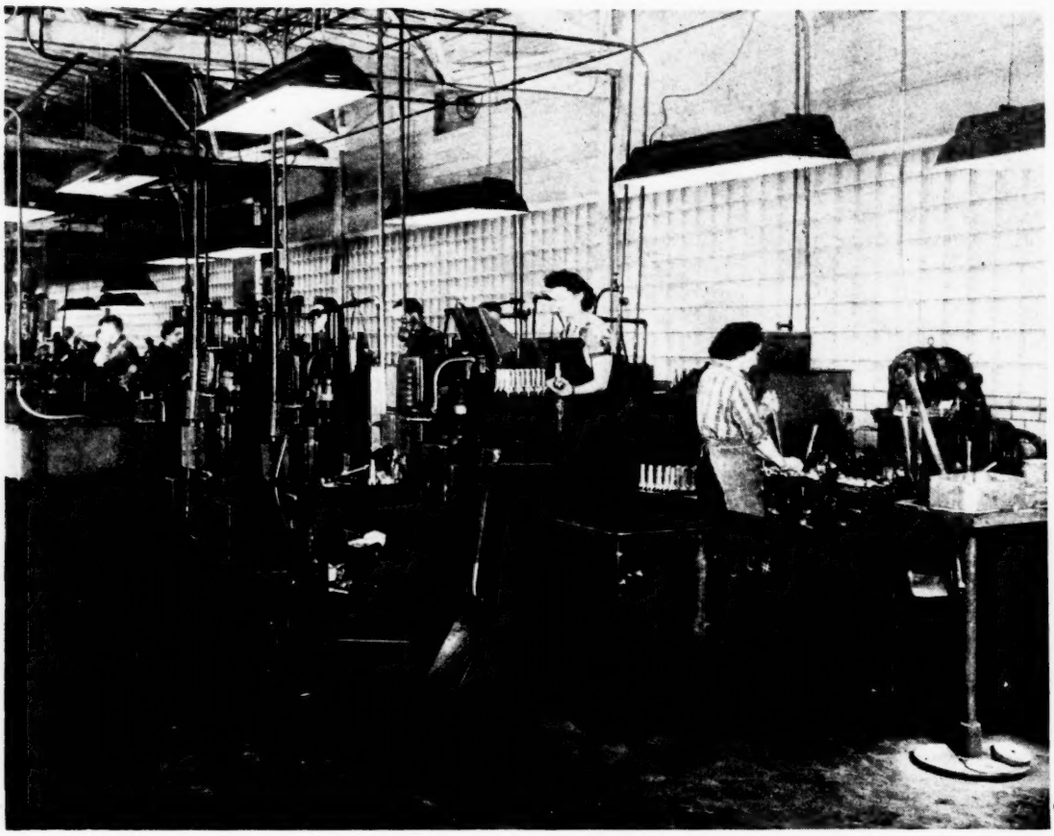


Fig. 14. A view
the machine sh
Nylen Products

about $1,800 more than it would have cost to install the cheapest equipment necessary to waste the heat.

The heat recovery equipment paid for itself in a little over a year and is now earning 86% on the amount invested in additional equipment.

A picture of the engine room showing the two engines now in operation in the foreground, and the new engine (not yet in operation) in the background is shown in Fig. 11.

One group of unit heaters is pictured in Fig. 13. The water circulating pumps are shown in Fig. 10. The auxiliary oil fired boiler is shown in Fig. 12.

The new engine now being
stalled will also have a combi
cooling and heat recovery unit. T
is of the central station type,
charging the air through duct w
to heat another factory building
winter, and to ventilate and coo
in summer. In this way a d
service is obtained.

Designing Stokers

so that they will burn available low grade fuels

CHARLES HALLMAN

UNPRECEDENTED demand for high grade steaming coals by war goods manufacturers has greatly depleted the available coal supply. Increased production has called for more steam for heating and manufacturing processes. Better heating is required in plants where women are employed. These additional requirements have not always been accompanied by the priority approval to purchase additional steam generating equipment, nor in many cases was it practical to enlarge the boiler plant. In most instances the best answer was to buy premium coal to boost the capacity of the fuel burning equipment and "uprate" the boilers. Because of this heavy drain on our supply of good coals, the chances are that in the future we must learn to get along with the remaining poorer grades.

In pre-war days the largest users of premium coal were those who purchased from 10 to 50 carloads per year. This range covers many small industrial plants, good size apartment houses, office buildings, laundries, schools and hotels. Most users of mechanical stokers, other than domestic users, come within this bracket. Closer analysis further discloses that the majority of these coal users generate either high or low pressure steam in the conventional horizontal return tubular or the firebox type boiler ranging in size from 75 to 200 hp. This apparent sizable market for mechanical stokers has induced over 100 manufacturers of single retort underfeed type stokers to compete for this business.

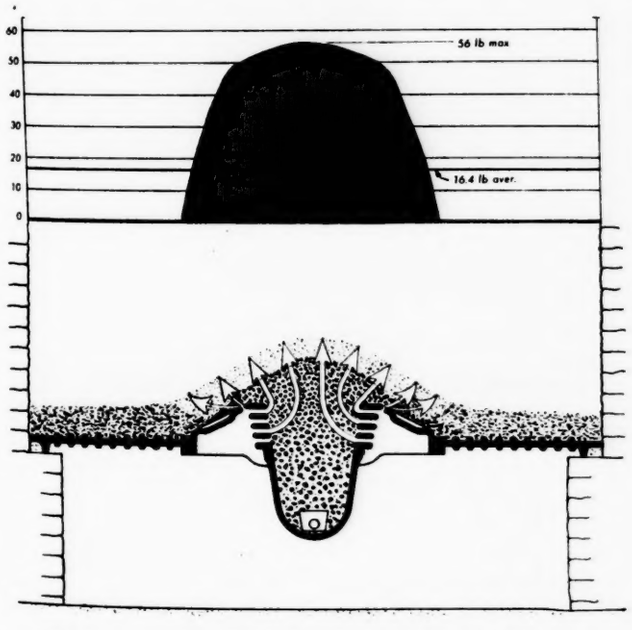


Fig. 1. Profile capacity curve for dead plate type stoker illustrated.

With this highly competitive condition, it follows that much inferior equipment has found its way into use. For the same reason, many stokers installed in the past 15 years under 75 to 200 hp boilers are inadequate in size to develop the required capacity when burning the poorer grades of coal available today. Undersized stokers require special coal to meet the required load.

Besides the tendency to install stokers of inadequate capacity for competitive reasons, there are many cases where the actual requirement is inadvertently underestimated. Those who compete primarily on a price basis are quite universal in the practice of offering only sufficient stoker capacity to take care of the rated horsepower of the boiler. The rated horsepower of a boiler is strictly a function of the heating surface. The developed horsepower depends on how much steam can be generated with that heating surface.

It is not uncommon for hand-fired boilers having ample grate area and sufficient chimney to develop from 25 to 50% more than the rated boiler horsepower. For this reason the only safe method of arriving at the required stoker capacity for a boiler already installed is to consider the maximum generating capacity of the boiler, including possible overrating. The horsepower a given boiler can generate in excess of its rated horsepower depends on the type boiler. This is well established by engineering standards for each type.

An underestimated stoker capacity bodes trouble for the coal dealer.

Live Grate Area is Important

For the past 35 years, it has been known by designers of underfeed stokers that the proper burning of clinkering, high-ash, low-heat value type coals is entirely a matter of furnishing a sufficient live grate area. Practically every type of commercial coal can be burned satisfactorily on an underfeed stoker if sufficient live grate area is provided to suit the requirements of the particular coal to be burned.

Live grate area is defined as that portion of the gross projected area of the stoker that both supports the fuel bed and admits air for burning the coal. The amount of coal burned on the stoker grates is proportional to the amount of air passing through the fuel bed. The determining factor governing the capacity of a stoker unit is the area of air-swept coal surface. It is an unusual case when the air or feeding capacity limits the pound of coal that can

be burned per hour on a given machine. It is rather the ability of the stoker to bring sufficient air into intimate contact with the coal in the furnace. In the case of an underfeed stoker, a loose fuel bed with air trickling through a great many crevices covering a large grate area, is essential to good operation.

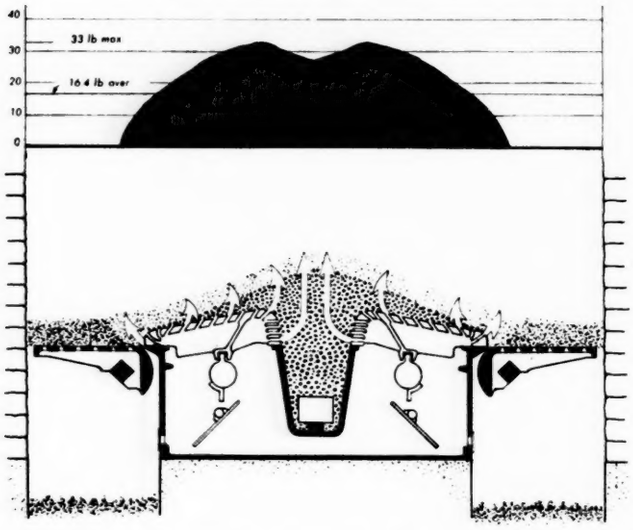


Fig. 2. Profile capacity curve for live distributing grate type stoker illustrated.

To obtain good operating conditions, fuel burning rates per square foot of live grate area must be held within reasonable limits. Greater air pressure is needed to force the quantity of air necessary for high fuel burning rates through the same area and overcome the friction of the restricted area. A large quantity of air being forced through the fuel bed at high static pressure is equivalent to a blow torch action on the top layer of fuel. This causes such a high temperature at the point of impingement that the fusing temperature of the ash is exceeded in low-fusing temperature ash coal.

The result is the formation of a large clinker or the ash may flow like a liquid. Liquid ash may trickle through the fuel bed freezing the coal into clinkers as it flows or clog the holes in the grates where air is admitted. When a fuel bed gets into the condition of a sticky mass of fused ash it is time to order a better grade of coal with a higher fusing temperature ash.

Stoker engineers who realize that limited coal burning rates are important from the standpoint of using low grade fuels, have devised the Profile Capacity Curve to determine the rate of coal burning at various points in the fuel bed.

The cross-section of the stoker shown in Fig. 1 is representative of a number of "dead plate" type stokers. The accompanying Profile Capacity Curve represents a condition when enough coal having 12,500 Btu per pound of coal is burned on a stoker 6 ft wide by 6 ft long to develop 150 hp. If each square foot of gross grate area (36 sq ft in this case) burned an equal quantity of coal, it would only be necessary to burn 16.4 lb coal per sq ft. Actually, due to the restricted live grate area, coal burning rates as high as 56 lb per sq ft are recorded on the Profile Capacity Curve.

Fig. 2 illustrates the cross-section of a live distributing grate type stoker having the same gross grate area and operating under the same conditions as the stoker illustrated in Fig. 1. Note that the Profile Capacity Curve for this stoker shows a maximum coal burning rate of only 33 lb per sq ft due to the increased live grate area. The distributing action of the grates with this type stoker allows a thinner fuel bed in normal operation without the necessity of hand working. The great advantage of the distributing type grate is the self-cleaning feature of the air admitting holes, as well as the space between the grates which is also air admitting space. This insures a free air passage after long periods of operation and maintains a porous condition of the grates as well as the fuel bed.

It is recommended that the mystery of the actual ratings of single-retort underfeed stokers be cleared away. The interests of the coal business, purchasers of stoker equipment and manufacturers of stokers would be served best if ratings were set up for the coal *burning* capacity instead of the meaningless coal *feeding* capacity. Capacities should be rated in accordance with some maximum coal burning rate as shown on the Profile Capacity Curve. This should be sufficiently low as to permit the use of the more abundant poorer grades of fuel.

Oil Viscosities Revised for West Coast

Minimum viscosities for various grades of civilian fuel oils to be manufactured, delivered, or received in the Pacific Coast States were announced June 28 by the Petroleum Administration for War.

Action was taken by issuance of a formal order which became effective June 28 and applies only to California, Oregon, Washington, Arizona, and Nevada.

Explaining the need for the order, Deputy Petroleum Administrator Ralph K. Davies said that it is necessary to protect the Nation's supply of 100-octane aviation gasoline, Navy special fuel, Navy diesel oil, and other petroleum products required by the armed forces. Since these products in part come from the same cuts of crude oil that also produce home-heating and industrial fuel oils, it has been deemed necessary to establish minimum viscosities for civilian fuel oils.

Viscosity minima for the various grades of fuel oil listed by the order follow:

Furnace oil—not less than 43 Saybolt Seconds Universal at 100F; light domestic fuel—not less than 35 Saybolt Seconds Furol at 122F; bunker grade fuel—not less than 150 Saybolt Seconds Furol at 122F, and railroad and heavy industrial fuel—not less than 200 Saybolt Seconds Furol at 122F.

WASHINGTON NEWS

Summarized by Loring F. Overman; Peacetime AC Plans Studied by W.P.B.; Freon Amendment on Order M-28 Due.

"What is Past is Prologue."

This solemn pronouncement, chiseled deeply into one of the marble columns fronting the National Archives Building in Washington, is again to be put to the test, and with the Refrigeration and Air-Conditioning industries involved. For by a study of the past — the year 1940, to be exact — the Air-Conditioning and Refrigeration Section of the War Production Board will draw up the rules charting the return of these industries to civilian production.

Not that any immediate need for these charts is in prospect, no indeed, but currently successful operations in France and the Pacific indicate the advisability of having the charts in readiness at the earliest possible moment. The planning work was scheduled to start July 10, deadline for the return of industry questionnaires developed by the WPB and the general air-conditioning and refrigeration industry advisory committee for the purpose of providing a complete picture of how the industry functioned from a production standpoint during 1940 — the last normal year prior to the war.

By means of the questionnaire data, the War Production Board expects to have available a type of information more complete than anything previously available. The form of the questionnaire was approved by the industry advisory committee at the meeting in Washington, June 14, and copies were immediately printed and forwarded to manufacturers. Part I of the questionnaire (refrigerating unitary equipment), was sent to all known members of the industry, while Part II (air conditioning and refrigeration equipment) was sent to some 50 or 60 manufacturers of high-and-low-side equipment and air conditioning.

Part I covers walk-in coolers and cold storage doors, reach-in refrigerators, display cases, bottled beverage cooling equipment, Bulk beverage dispensing equipment, soda fountain equipment, low temperature freezing and dispensing equipment, and drinking water coolers. Manufacturers are asked to report the number of units manufactured and the dollar value of each type by sizes and styles, and to indicate for each the purchases of components from other manufacturers.

Part II requests similar information concerning complete condensing units, compressors and compressor units, centrifugal refrigerating machines, heat exchanger equipment and self-contained air-conditioning units.

The resultant information is expected to provide not only a general picture of the industry's operations, but a plant-by-plant analysis of output. With this complete breakdown as a guide, the WPB believes it will be in a position to give the reconversion signals at times and to plants least needed in the final phases of the war and most needed to bring the entire industry back into civilian focus at the earliest possible moment.

Needless to say, the position of a plan prior to the war, as indicated by the production questionnaire, will have a bearing on its early allocations of materials when reconversion time comes.

Present at the industry advisory committee meeting at which the questionnaire was approved were W. H. Aubrey, Frick Company, Inc., Waynesboro, Pa.; Frank Faust, General Electric Company, Bloomfield, N. J.; H. F. Hildreth, Westinghouse Electric and Mfg Co., East Springfield, Mass.; H. T. Jarvis, Refrigeration Engineering, Inc., Los Angeles; Wayne D. Jordan, the Liquid Carbonic Corp., Chicago; Charles Knox, Baker Ice Machine Co., Inc., Omaha; Willard L. Morrison, Motor Products Corporation, North Chicago, Ill.; M. G. Munce, York Corporation, York, Pa.; T. S. Pendergast, Universal Cooler Corporation, Marion, Ohio; A. B. Schellenberg, Alco Valve Co., St. Louis; C. E. Scott, Fedders Manufacturing Co., Buffalo; F. K. Smith, Tecumseh Products Co., Tecumseh, Mich., and Karl Weber, Weber Showcase and Fixture Co., Los Angeles.

Motors Tight

Committee members told WPB officials that motors are the greatest industry bottleneck at present, with delivery time ranging from 10 to 12 months. Mr. F. W. Gardner, director of the General Industrial Equipment Division of WPB, replied that an effort to supply motors for more essential users first would include, after July 1, special authorization by WPB before purchasing fractional horsepower motors as well as some of the smaller integral horsepower motors. The requirement for special authorization will apply to all orders already placed with motor manufacturers.

Refrigeration Repair Parts

Sterling Smith, General Industrial Equipment Division, WPB, reported that some of the committee's recommendations regarding uprating of refrigeration repair parts, submitted at the May meeting, had been favorably acted upon. An AA-1 rating for production materials for MRO orders, when filed against Code 815, and letters have been sent to the industry, suggesting that CMP-4B applications for materials for repair parts production be filed against Code 815.

Authority to uprate orders for certain types of repair parts, if the orders were placed prior to February 1, has also been granted, Mr. Smith reported. Air-cooled and water-cooled condensers have recently been added to the list of items approved. Mr. Smith commented that although the information regarding uprating was telegraphed to the trade, few requests for uprating have been received by the Refrigeration and Air-Conditioning Division.

Mr. Smith also indicated that an amendment to Order L-63, which will in effect remove the inventory restrictions on refrigeration repair parts, is soon to be issued by WPB.

Freon Amendment Due

Latest bug in the Freon production program is that cylinders could not be filled during May as rapidly as the gas was produced, it was reported by F. B. Millham, Administrator of Order M-28, the Freon allocation order. May production totalled 3,250,000 pounds, with all plants producing at maximum capacity.

An allocation of 600,000 pounds has been set up for civilian and industrial uses during June; of this amount, 335,000 pounds have been allocated to contract agents for distribution through jobbers and distributors. The Freon inventory on June 1 was slightly more than 1,000,000 pounds.

Lack of raw material is holding up completion of the East Chicago plant. If the scheduled delivery date of July 20 is met, one of the East Chicago plants will become operative by August 15, and another 500,000 pounds of Freon will be produced in August. The East Chicago project consists of two plants, each of which will produce 1,000,000 pounds of Freon monthly.

Early issuance of an amended version of Order M-28 to state the policy

of the WPB appeals board with regard to granting appeals for Freon for air-conditioning systems which are denied replacement charges under the order, is expected. The order lists a score of types of comfort air-conditioning systems for which no Freon will be made available, but it has been the policy of the WPB appeals board to make occasional exceptions when certain conditions are present. In granting such appeals the function of the building is taken into consideration, as are facts indicating whether the air conditioned space can be ventilated by other means. Enclosed inner space, buildings constructed without windows and construction in which air-conditioning is an integral part are sometimes eligible for consideration.

The proposed amendment would permit the General Industrial Equipment Division to authorize the use of Freon, within certain policies, without the necessity of having to follow the present appeals board procedure. Members of the Industry Advisory Committee were unanimous in their approval of the proposed amendment. They pointed out that the policy is established, and that to avoid the possibility of favoritism, attention should be called to the policy through the publicity that will result.

L-38 to be Clarified

L-38, the controlling order governing manufacture of refrigeration equipment, has been redrafted for the purpose of simplifying provisions to permit the Division to implement programs more promptly. Under the proposed plan, all of the present lists would be eliminated and a rate of production would be set up through quota schedules. In its revised form, the Order would permit production schedules to be expanded or contracted to reflect wartime developments, or to permit post-war conversions.

Small Plants Favored

Those engaged in heating, ventilating and air-conditioning will find reassurance in the fact that post-war planning within their own division of WPB is keeping pace with the general planning along this line in Washington. The Division's industry questionnaire, it will be noted, was in circulation several days before the Smaller War Plants Corporation's announcement, on June 27, of a plan designed to give small plants a greater participation in essential civilian production, and to grant them partial relief from production quota restrictions.

In broad terms the objective of this plan is to permit small plants to increase their operations to a rate which is equal to the overall industry rate of production for any given civilian item. Under present conditions quotas of allowed production for civilian end use are set by WPB limitation orders. Production of civilian items for military use is excepted. Since it has been the tendency of procurement agencies to place military orders with larger plants, many of these have been operating well over rated capacity. On the other hand, small plants, because of the lack of military procurement, had to be satisfied with a certain minimum percentage of their base year production.

Under the new program, small plants will be permitted a rate of production on civilian items by the relaxation of quotas, so that no small plant in the industry will be operating below the overall production level of the industry, including excepted military items.

"G. I." Bill Opens Field

Signing on June 22 of the "G. I. Bill of Rights" by President Roosevelt, providing among other things, for half a billion dollars worth of new hospital construction, opens new opportunities for those interested in engineering and equipping structures of this type.

The G. I. Bill, it is explained, merely authorizes certain expenditures for hospitals; actual construction cannot be started until Congress grants definite appropriations, in response to requests from the Veterans' Bureau.

The Veterans Administration recommended on July 4 that the Federal Board of Hospitalization approve new building projects in twenty States for 16,000 additional hospital beds for veterans.

Brig. Gen. Frank T. Hines, Veterans Administrator, said that the program, estimated to cost $70,000,000, was the first step in the G.I. hospitalization program.

The new beds will include 5,000 for neuro-psychiatric patients, 3,000 for tuberculosis sufferers and 8,000 for general medical and surgical cases.

States in which the new facilities will be located are New Hampshire, Rhode Island, Delaware, Virginia, Florida, Michigan, Kentucky, Louisiana, Mississippi or Alabama, Eastern Kansas or Northern Missouri, Eastern Montana or Western North Dakota, Colorado, California, Texas, Washington, New York, Georgia, Ohio, Pennsylvania and Illinois.

Fuel Situation

A daily production rate of 4,907,700 barrels of petroleum products, an all-time high production rate, has been authorized for July by Deputy Petroleum Administrator Ralph K. Davies.

Coal production during the week ending June 17 declined 237,000 tons under the output of the preceding week. Most recent estimates indicate that bituminous production may fall some 30,000,000 tons below requirements and the production of domestic size anthracite is expected to be approximately 5,000,000 tons short.

Relaxation of Limitation Order L-74 (oil burners) to permit production of a limited number of Class B (residential) oil burners to replace old equipment that is badly worn or damaged beyond repair was recommended by the oil burner industry advisory committee at a meeting in mid-June.

The committee reported to WPB that no production of domestic oil burning equipment has been permitted, except on rated orders, for more than two years, and present stocks of Class B oil burners are now far below minimum inventory levels, WPB said.

The present inability of dealers to get necessary replacement oil burners for their customers has put an undue burden on the public and the industry to keep the installed equipment operating at a sufficiently high level of efficiency to maintain a healthful condition in users' homes on their rationed allotment of fuel oil, according to the committee's report. Some new production for civilian use is imperative, members of the committee said.

Minimum needs for replacement purposes can be met without interference with war work in manufacturers' plants, and with a minimum of skilled labor, the report said.

Warfare in the Pacific, increasing daily in scope, will necessitate continuation of fuel oil rationing in the Pacific Northwest indefinitely, Deputy Petroleum Administrator Ralph K. Davies stated recently.

Water Heaters

Provisions have been made to allow production of more durable and satisfactory direct-fired side arm and indirect water heaters, hot water storage tanks and range boilers, WPB announced June 5.

Action also was taken to restrict production of range boilers and expansion tanks to 70% of unit output during 1941, and hot water storage tanks to 75% of 1941 unit output. Previously no percentage quotas were established on such equipment which could be produced, but allocation of material for production of the equipment was controlled. Since a program recently has been approved for production of these items according to stated needs, it was necessary to establish definite percentage quotas to equalize production and essential requirements, WPB said.

The actions were taken in amendments to two orders, L-185 (Water Heaters) and L-199 (Plumbing and Heating Tanks).

Air Conditioning by Gas

Field Findings from a Number of Existing Gas-operated Installations

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LAST autumn, the Testing Laboratories of the American Gas Association completed their technical investigation of equipment for comfort air conditioning with gas, and published the results in Research Bulletin No. 18. Supplementing the investigation of design features and operating characteristics, based on models submitted by manufacturers for comprehensive tests, the Laboratories undertook a survey of field experience acquired with existing installations. About twenty gas utilities were asked to fill out data forms dealing with investment costs, gas and electric consumptions, cooling water requirements, general performance, servicing requirements, and customer satisfaction. A summary of replies was compiled, but the committee decided that further study of field conditions and inclusion of any obtainable 1943 performance data would be advisable, before making the results public. The present paper is intended to accomplish the purposes as outlined.

Summary of Findings

Main conclusions from the field data and supplementary sources are:

1. Investment cost for air conditioning installations is still comparatively high—between $2,000 and $2,500 for complete year-round system to serve a 6- to 8-room residence.

2. Reduction of cost to $1,500 level, now set as the immediate objective, will require not only quantity production of equipment, but also simplification of field installation methods and the introduction of lower-cost alternate materials.

In this survey, the predominance of one make of equipment should not be taken as implying belief by utility companies or by the committee for which the survey was made, that other types are not equally well suited to the needs of users, or advantageous to utilities as a source of gas and electric load.

3. Factory price of equipment, including cooling tower, together with transportation charges represents 40 to 60% of total cost; air ducts and grilles with thermal and acoustical insulation where required on ducts, account for 20 to 35%. These items generally determine the overall installation cost.

4. Gas consumption by 5-ton installation serving an average house is usually between 200 and 250 Mcf annually (1,000 Btu per cu ft); in the South, ratio of quantities for cooling and for heating is around 3-to-1 and in the North 1-to-4, or even lower.

5. For residential installations, the gas usage by all-year air conditioning is between 4 and 5 times that attained by all-gas service for the 3 major domestic appliances, i.e., cooking range, water heater and refrigerator.

6. Electric consumption by 5-ton residential installation with cooling tower is 3,000 to 3,500 kwh annually in the South and round 2,000 in the North; cooling tower contributes slightly over half the consumption in the South and less than one-third of annual energy used in the North.

7. There is wide variation in gas and electric consumptions by individual residential installations. In some cases, the quantities are as little as 20% of average, and in others, as much as 150%. Many causes are involved, some unpredictable and changing from one year to another, and usually related to the human element.

8. Small commercial installations show even greater variation than residential, as they embrace such differing requirements as 24-hour 7-day lunch rooms with high internal heat load at one extreme, and 7-hour 5-day private offices with small internal load at the other. However, group averages indicate investment costs about 20% lower than normal residential, and energy consumptions 10 to 15% less.

9. Revenues derived from air conditioning load, as reported on survey sheets, are at rates for the consumption incremental to customer's other load, between $0.40 and $1.05 per Mcf of 1,000 Btu gas ($0.04 and $0.105 per therm) with majority of installations within range $0.45 to $0.65; electric rates are 1.5 to 4.5 cents per kwh, with majority between 2 and 3 cents.

10. Servicing difficulties are receiving close attention by utility companies and equipment manufacturers. Some "modernization programs" have already been completed and others are awaiting release of critical materials. These and other measures are eliminating the principal weaknesses disclosed by field experience. Already, it is practicable to institute servicing plans acceptable to customers, which will make routine maintenance a self-supporting activity.

From a report to be issued by Joint Committee on Gas Summer Air Conditioning of the American Gas Association.

11. Statements secured from owners and users are evidence of good reputation established by gas air conditioning equipment and by the sales and servicing departments of utility companies and equipment manufacturers. Owners are recognizing and making due allowance for newness of designs and for handicaps imposed by wartime limitations.

12. Compared to status reached in comparable development period by older mechanical and electrical apparatus, such as the automobile, radio, household refrigerator, the technical advance and public acceptance attained by gas air conditioning since it started to gain momentum in the late 1930's, have been quite creditable and provide a sound foundation on which to build for the future.

Recommendations for Future Work

Information entered on field data sheets does not disclose need for specific action by equipment manufacturers, utility companies or Joint Committee, at this time. Moreover, manufacturers are already redesigning their units to incorporate improvements, simplification where feasible, and particularly modifications to expedite quantity production. For this reason, a close analysis and detailed report of operating characteristics and servicing requirements of existing installations would be of little value to the industry.

Two suggestions, however, appear to be in order. The statistics on energy consumptions and indoor conditions produced are still fragmentary, inconclusive, and in too many cases inconsistent. To aid in defining more clearly the circumstances under which summer and all-year air conditioning loads give maximum benefits to utility companies, a comprehensive survey procedure should be devised by the Committee and put into effect soon. Secondly, attention of all sections of the industry should be focused on the projects now being started by the Laboratories, under direction of Technical Advisory Committee, namely, study of air distribution principles and duct systems, and investigation of water treatment to overcome scale-deposit and corrosion troubles in cooling towers and refrigeration units. These factors have greater influence on ultimate expansion of the market for residential and small commercial air conditioning than any other of the elements so far disclosed by field experience.

Installations and Geographic Distribution

Comfort air conditioning with gas, which started more than 15 years ago, is now firmly established. There are some 400 installations, aggregating more than 5,000 tons cooling capacity, in residences and on premises of small commercial users. Most of them utilize the principle of absorption refrigeration or of adsorption dehumidification with supplementary cooling. An appreciable number of gas engines driving refrigeration compressors are included, but promotion of gas as fuel for prime movers in air conditioning service has not been active during the past half decade. In a recent article, reference was made to 100,000 tons of gas air conditioning now in operation. This higher figure includes industrial applications as well as comfort, and a number of large installations employing refrigeration equipment of steam-jet vacuum type or turbine-driven centrifugal compressors, in which the application of gas is for firing steam boilers.

Operating statistics obtained from the field last year, in a survey initiated by the Joint Committee and handled by Laboratories, cover about one-quarter of the total number of installations in service; classification by equipment types follows:

	Units	Rated Tons
All-year systems with absorption refrigeration		
Residential	41	183
Commercial	66	310
Systems with absorption refrigeration producing chilled water		
Residential	2	34
Commercial	1	8
Adsorption dehumidification systems		
Residential	1	5
Commercial	2	4

The numbers of installations tabulated are not proportional to aggregate quantity of equipment of the several types, produced by the respective manufacturers.

More than 90% of reported installations is in the Gulf States region and in California. There are a few scattered installations elsewhere, including several in North Atlantic States.

Types of Equipment Covered by Investigation

Data sheets for assembling field information were arranged to fit all types and makes of gas-operated equipment, including absorption refrigeration, adsorption dehumidification, engine-driven compression units and any others. In the replies, Servel absorption type comprises a large majority, i.e., all but 6 of the 113 units listed, as indicated in classification below:

	Installations	Units	Rated Tons
Servel			
Residential	35	41	183
Commercial	52	66	310
Williams			
Residential	2	2	34
Commercial	1	1	8
Bryant			
Residential	1	1	5
Commercial	2	2	4
	93	113	544

Main factor determining type of equipment reported is availability of data in utility-company files.

Investment Cost Data

Analysis of the 93 installations reported to committee, which involve 113 units with aggregate capacity of 544 tons, shows average and spread of installed costs for the complete systems. Servel models rated 5 tons predominate. For these, the average costs are:

	Per Ton
Residential	
With cooling tower	$522
Without cooling tower	355
Commercial	
With cooling tower	411

No figures were submitted for commercial installations without cooling tower. Differential shown for residential systems, with and without cooling tower, should not be taken as an indication of incremental cost for tower in a particular case. Numbers of installations reflected in the stated average costs are insufficient to eliminate effect of the many variations in local features which determine overall job costs. Bryant and Williams installations appear to have costs closely comparable with the Servel.

Commercial installation costs reported in survey are about 20% lower than for residential. This is attributable to simpler duct systems, less cutting and patching, availability of space for equipment, better facilities for performing erection work, and similar factors. Such differential is confirmed by experience of one company active in the pioneering of gas air conditioning; in years 1940 to 1942, the commercial installations completed had per ton costs 37, 23 and 26% respectively, lower than the residence class.

An objective agreed upon jointly by utility companies and equipment manufacturer is to bring cost of an average 5-ton residential installation down to approximately $1,500, or $300 per ton, within two or three years after manufacture of improved models is started. This will demand close scrutiny of all components of factory and field costs, and the devising of simplified erection practices along with introduction of less expensive materials. In order to judge relative importance of apparatus and of materials and labor involved in the field work, analysis has been made of past installation cost records for residential and commercial applications, to find what percentage of total cost is comprised in the main components, i.e., air-handling unit with refrigeration element, the cooling tower, and the duct system. Information entered on Committee data sheets is summarized:

	Per Cent of Total		
	Unit	Cooling Tower	Duct System
Residential			
Rating 3 tons	55	17	11
Rating 5 tons	40	10	23
Commercial			
Rating 5 tons	50	12	15

Duct systems include sheet-metal work and grilles, but not insulation; latter represents about 3% under average conditions.

For Bryant installations, the dehumidifier unit amounts to 53% and the duct system 12%. Williams installations have 37% of cost chargeable to refrigeration unit, 9% to cooling tower and 15% to duct system.

From another source there has been secured an itemization of installation cost components determined from records of 51 installations made in 1941 and 1942. This information follows:

	Per Cent of Total	
Itemization	Residential	Commercial
Conditioner	42	49
Cooling tower	11	12
Freight and hauling	3	4
Duct system	20	13
Grilles and registers	3	2
Duct insulation	6	4
Plumbing	4	3
Electric	2	2
Engineering design and supervision	7	9
Miscellaneous	2	2
	100	100

Classification does not include thermal insulation for building, nor major alterations and special housing sometimes required for equipment placed on a porch or located alongside the building. These items may represent $200 to $500 where circumstances are unfavorable, and if inserted in the job cost account would materially reduce percentage figures for each of the normal components as listed.

Energy Consumption

The reported data on gas and electric consumptions demonstrate once more the irregularities and contradictions that are common in "before and after" determinations of energy use for a particular utility service. For example, the Laboratories' summary of gas usage shows the following average increase in annual sales attributable to Servel installations with cooling towers, made by three companies:

Model	No. of Units	Gas, Mcf
3-6	1	683
3-12	3	119
5-12	18	135
5-18	8	133

First entry is impossible to reconcile with the others or with rated burner input; last entry should be higher than the one preceding, since it has fuel input rating 50% greater for heating cycle. Corresponding data for installations without cooling towers are:

3-6	0	—
3-12	4	227
5-12	1	290
5-18	2	264

These consumptions are all inconsistent with preceding group.

The same conditions are found in electric energy summary:

	With Tower		Without Tower	
Model	Units	Kwh	Units	Kwh
3-6	1	12,638	0	—
3-12	3	3,734	2	1,009
5-12	15	2,248	1	427
5-18	8	2,705	2	2,250

Here the differences are in the right direction, i.e., installations with cooling towers using more energy than those without, but relation between respective sizes of units is illogical.

To get usable information, it evidently is necessary to discard from averages any exceptional cases that cannot be adjusted to normal operating conditions, and to segregate installations by classes (residential and commercial) and by climatic regions.

(Concluded in the next issue.)

Automatic Coal Scales Aid Fuel Saving

IN wartime, certain decisions on conservation are difficult to make. For example, some equipment does use critical metal but, on the other hand, conserves critical fuel.

In this group one may include automatic coal scales, which for years have been installed for the prime purpose of determining boiler plant economy; the initial cost of scales is ordinarily warranted on the basis of saving fuel consumption alone and deemed just as important as time clocks and cash registers are in other fields.

Control for Boiler Operation

Examining into the matter beyond the mere question of money saving, and keeping in mind that much more coal is now being used in an ever-tightening transportation situation, we may find sufficient justification for the use of automatic coal scales as a form of control for maintaining boiler operation in war production plants at maximum efficiency. If this is not done, additional boiler capacity may be required, with consequent delay in production and a greater use of critical materials of an even more valuable nature, such as boiler plate.

Proper accounting in the boiler room will indicate daily how much coal is being used and how much is going into the ash pit as combustible, or up the chimney as flue gases. In short, this accounting has increased Boiler Efficiency as its objective.

The evaporation rate in pounds of steam per pound of coal for each boiler can be ascertained continuously, as the coal scale provides a continuous test or check at all times. By checking one boiler against the other, all may be kept operating at the maximum rate In order to know whether this rate could be raised say one-half pound, or from 9.5 to 10.0 pounds of steam per pound of coal, the weight of coal must be recorded automatically. One-half pound in this instance would represent 5% in coal consumption, and when computed annually is interesting as a saving.

On the basis of known boiler efficiency when ascertained with coal scales, it is no longer a question as to which coal is the most economical to burn. As an example, let us take two coals as follows which, in actual operation, have an efficiency of 55% and 58%, respectively.

Comparison of Coals

From evaporation tables:

(a) Coal at 13,000 btu gives 7.36 lb of steam for 1 lb of coal (boiler efficiency at 55%);

(b) Coal at 14,000 btu gives 7.6 lb of steam for 1 lb of coal (boiler efficiency at 58%).

Therefore, the coal per 1,000 lb of steam for the two grades is as follows:

(a) $1000 \div 7.36$ equals 136 lb of coal at, say $5.60 per ton, equals 38.4 cents cost per 1,000 lb of steam;

(b) $1000 \div 7.76$ equals 129 lb of coal at, say $6.10 per ton, equals 39.2 cents per 1,000 lb of steam.

Scales Can Show Savings

The saving by using the lower grade coal over the higher grade is then 0.8 cents for each 1,000 lb of steam. Use of automatic coal scales, therefore, as part of the necessary boiler controls, in determining this boiler test, can aid in effecting savings not only in the quantity of fuel consumed but also in the fuel cost and the possible use of lower grade coal.

Critical materials required in the fabrication of one typical 200 lb automatic coal scale are only 1461 lb of carbon steel (for castings, sheets and strips and structural shapes), 18 lb of alloy steel (for sheets), and 8 lb of copper base alloys (for sheets, rods, bars, wire and castings).

Automatic coal scales serve in most cases as bunker unloading systems, combining a weighing and collecting system, reducing the dead storage in the overhead supply and effecting a saving in bunker and building construction. In addition, these systems are completely automatic, eliminating the human element, thus providing a saving in labor.

—T. W. Reynolds

NEWS OF THE MONTH

Invasion Vessels Have Controlled Ventilation

NEW YORK—The part played by over 4,000 ships in landing Allied troops on the French Coast, and the continued supplying of these fighting men with tons of equipment, food and reinforcements, has heightened interest in the successful solution of one of war's major transport problems, the conversion of portholeless ships into heated and ventilated troop carriers.

The Sun Shipbuilding & Drydock Co., Chester, Pa., builders of these vessels which were originally intended for tank carriers, point out that as carriers the ships were constructed without portholes. In converting the ships into transports, each capable of carrying thousands of troops, it was necessary to find ways and means to supply both fresh air and heat to troop and crew quarters. The only inlets for fresh air were through narrow companion ways.

The problem was to furnish not only outside air and heat, but enough of each to provide specific amounts to each troop, and to be able to control both temperature and ventilation at all times and in various quarters, even though one or more parts of the ships might be put out of commission.

A few of these ships are now in commission, while others are being constructed or converted. Each ship is equipped with Minneapolis-Honeywell pneumatic systems which control heat and ventilation through a multiple fan and carrier arrangement. Each ship has 18 of these systems.

Contractors Hear J. F. Lincoln at Convention

CLEVELAND—Speaking at an afternoon session devoted entirely to welding, J. F. Lincoln, president of The Lincoln Electric Company, manufacturer of arc welding equipment, addressed the Heating, Piping and Air Conditioning Contractors National Association on "The Future of Welding" at the Association's 55th annual convention, May 31—June 2.

Mr. Lincoln pointed out that undoubtedly industrial progress in the next 50 years will be even greater than in the past 50 years and called on the association to give their imaginations free rein. He stated that there were newer and better ways of doing almost everything in industry if people were only smart enough to figure them out.

Complimenting the association on the work they were doing to simplify welding procedures and practices, Mr. Lincoln traced the development of the welding industry through the early days of hamstringing legislation and restrictions, up until the present time where it is being adopted as the most useful, valuable and economical method of fabricating everything made of metal. He pointed to a bright future, especially in the field of arc welding where less than one out of every three places where the application of arc welding could be helpful are now using the process.

After the address by Mr. Lincoln, there were demonstrations of arc and gas welding on piping.

Atlanta Plans A.C. Trolleys

ATLANTA—Atlanta may be the first city in the United States to have an air-conditioned trackless trolley.

The Georgia Power Company is reported to have ordered equipment from one of the manufacturers of air-conditioning machinery. It will be installed in one of the company's trackless trolleys around August 15 for experimental and testing purposes.

This experiment is being made to determine, first, whether the air-conditioning machinery can be used successfully in such a vehicle; and, second, whether the results will justify the expense. These tests are included in the plans for the modernization of Atlanta's transportation system.

Ickes Names More Fuel Conservationists

WASHINGTON—Secretary of the Interior Harold L. Ickes announced on May 17 the appointment of 58 additional coordinators in the national fuel-efficiency program, as signed pledges of cooperation from scores of industrial executives in all parts of the United States began pouring into the Bureau of Mines at Washington, D. C.

Now totaling 76, the list of coordinators who will direct a staff of approximately 5,000 regional engineers —including some of the nation's foremost fuel experts— is expected to reach 300. These thousands of volunteers, mostly from industry, are serving without compensation to help the National Fuel-Efficiency Council and the Bureau of Mines achieve their campaign goal—a 29,000,000-ton reduction in the annual commercial and industrial consumption of coal and proportionate savings in other fuels.

Having completed the organization of local advisory committees, many of the coordinators have sent their staffs of regional engineers into action, calling at industrial and commercial plants in their areas to analyze fuel-utilization conditions, to offer suggestions for greater operating efficiency, and to distribute special technical literature prepared for the program by experts in the operation and maintenance of various types of fuel-burning equipment.

Boston ASRE Elects Ford

BOSTON—At the annual meeting of the Boston section, American Society of Refrigeration Engineers, May 4, the following officers were elected for the ensuing year: chairman, Austin S. Ford; vice chairman, A. L. Hesselschurdt; secretary-treasurer O. C. Eckels.

Plastic Pipe Future Portrayed

LOS ANGELES—The heating and air conditioning industries will find various uses for plastics in the post-war period, particularly in the field of plastic pipe in the smaller diameters, John Delmonte, technical director of the Plastic Industries Technical Institute, declared in a talk before the May meeting of the Southern California chapter of the ASHVE.

The speaker discussed various types of plastics, their characteristics, adaptability and application for use in industry. He cited the success which has already been attained under war-time conditions in the plumbing industry in the use of small-size plastic pipe, and said this field of plastic manufacture will undoubtedly be broadened after the war to include the manufacture of various types of plastic pipe used in heating and air conditioning installations.

New officers for the 1944-45 term elected at this meeting are: president, Leo Hungerford, Utility Fan Corp.; vice-president, M. Kennedy, York Corp.; secretary, Arch Theobold, Payne Furnace Co.; treasurer, Robert Law, U. S. Engineers. Board of directors: W. C. Stewart, Johnson Service Co.; H. R. Henderson, York Co.; J. G. DeFlom, Fluor Corp.; and Francis Hardner, H. L. McClelland Co.

Pressure A.C. for Superfortresses

WASHINGTON—Pressurized cabins—air-conditioned compartments in which superchargers maintain near-normal air pressure—make it possible for crews of the new B-29 Superfortresses to operate without oxygen masks at altitudes of 40,000 feet and higher, the War Department revealed June 21.

Also disclosing that an "unusual degree" of soundproofing and cabin-heating is made possible by the pressurized cabins, the War Department pointed out:

"Free from the necessity of wearing oxygen masks and from the sub-zero cold of high altitudes, the airmen complete a mission with a minimum of fatigue."

Pressurized cabins have been the subject of experimentation by Army Air Forces material command engineers at Wright Field, Ohio, since 1935. Boeing Aircraft produced the first pressurized cabin plane in 1937, which, known as the Stratoliner, went into commercial operation two years later.

Pointing out that fliers need oxygen to stay alive and function normally at altitudes over 10,000 feet, and that, at 40,000 feet, a flier would "die in a few minutes if he attempted to breathe free air," the Army explained that the only way to extend a flier's service ceiling above 40,000 feet was "to increase the air pressure at that altitude."

"As the result of many years of experimentation," it said, "this has been achieved in the B-29 in the same way that airplane engines are supercharged in order to get enough oxygen into their carburetors. This is done by compressing the air.

"The lungs of the flier in the B-29 are 'supercharged' by a machine which maintains the air pressure in the sealed cabin while that outside the airplane progressively decreases."

Engineers worried about what would happen if a cannon shell tore a hole in a supercharged cabin. An aviation physiologist, a major, volunteered to be the guinea pig. He entered a laboratory chamber in which stratosphere altitude was simulated. The chamber was sealed at one end with stout paper. A screw driver was plunged through the paper "drumhead."

"It was as if the major had been in an instant catapulted five miles up through the atmosphere," the Army related. "His cheeks and lips bulged and flapped, and his chest contracted spasmodically as the air was sucked from his lungs."

But he reached for his oxygen mask, donned it, and survived the experiment.

An actual test of "explosive decompression" occurred in one of the early flights. The side-gunner's blister blew out of a Superfortress at 30,000 feet. But the crew members all protected themselves with their oxygen masks and no one suffered.

Oxygen bottles are also attached to the parachutes that B-29 crew men wear, and the crew men are instructed in the free-fall technique of parachute jumping to avoid the danger of asphyxiation that may occur if the parachute is opened at an altitude of more than 30,000 feet.

Estimate Maintenance Expenditures

WASHINGTON—Owing to the wartime shortage of many building materials and of manpower, expenditures for maintenance and repair of residential and other construction during the current year are expected to be about 17% less than in 1943, according to a statement by James W. Follin, managing director of The Producers' Council, based on a report by The Council's market analysis committee.

The estimated expenditure of $3 billion for 1944 would be less than in any year since 1939, in spite of the great accumulated demand for repair work on the part of home owners, business concerns, and others, Follin said.

"The Committee estimated that expenditures for maintenance and repair will rise to $3.9 billion during the first twelve months after the war, but even this total, which is higher than in any preceding year, will not be large enough to enable property owners to catch up with all necessary repairs," Mr. Follin stated. As a result, expenditures for this purpose during the next five postwar years are estimated at the unprecedented figure of $5.4 billion annually, on the average.

Strouse Heads Buffalo Group

BUFFALO—Sherman W. Strouse has been elected president of the Western New York chapter of the American Society of Heating and Ventilating Engineers. Other officers elected are: 1st vice-president, F. A. Moselle; 2nd vice-president, H. Seelbach, Jr.; treasurer, B. C. Candee; secretary, Geo. E. Adema; board of governors, S. M. Quackenbush, M. C. Beman, Joseph Davis, D. J. Mahoney, W. R. Heath.

Backlog of Office Building A.C.

PHILADELPHIA—Air conditioning ranks prominently among contemplated postwar improvement projects for office buildings, the 37th annual convention of the National Association of Building Owners was told here June 21 by S. M. Buckingham, Cleveland, a regional vice-president of the organization.

Pointing out that most office buildings in the nation are at least 15 years old and that repairs and equipment replacements have been held to a minimum under wartime restrictions, he said a large backlog of structural improvements is being built up to help cushion the shock of peace and to provide quick employment in the early postwar period.

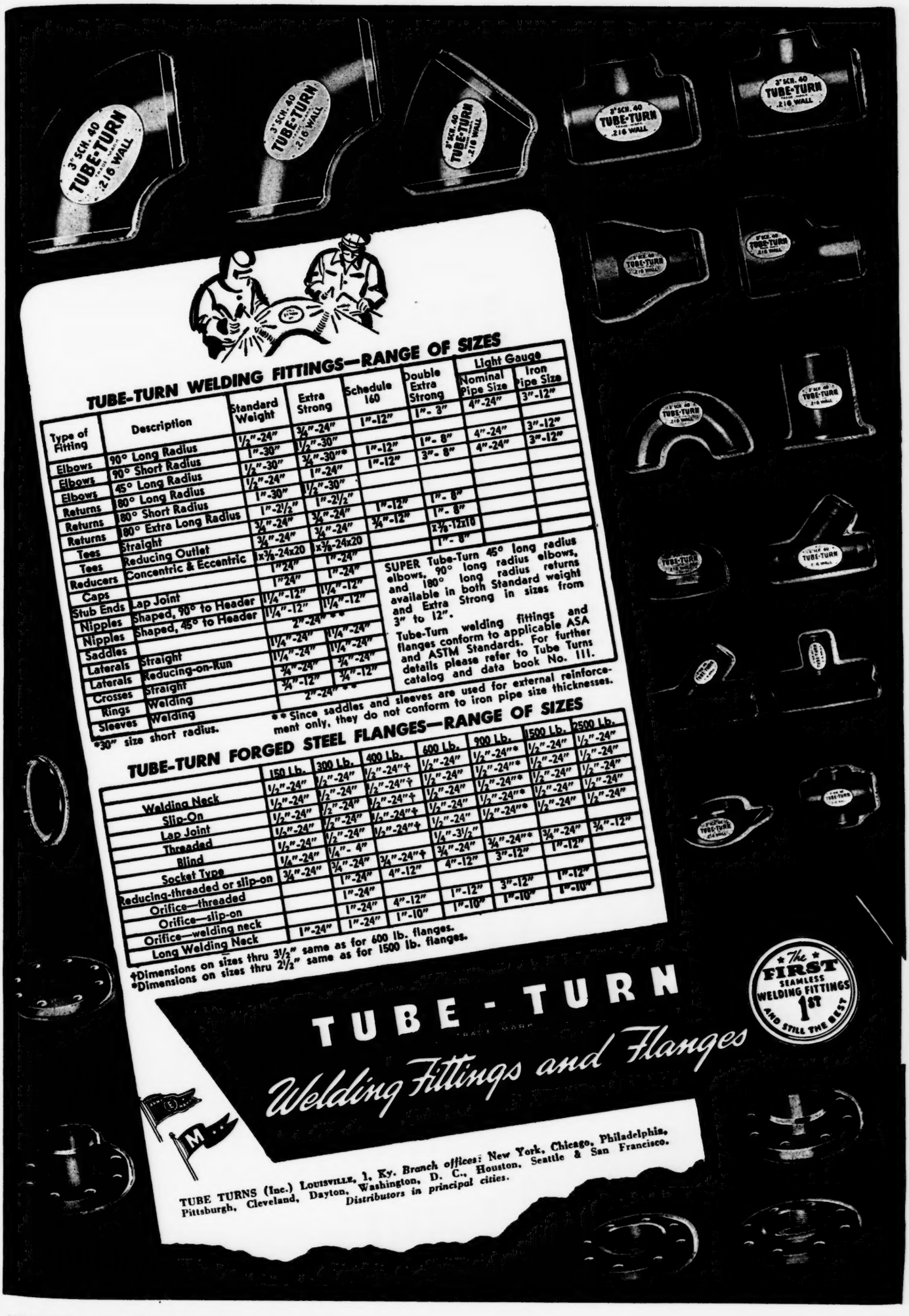
Buckingham announced that the first 238 key buildings in various parts of the country on which statistics had been compiled by the association showed plans for changes and replacements to cost more than $10,000,000. On that basis the 2,300 structures from which estimates have been requested will show prospective improvements involving about $100,000,000 for the readjustment period, he said.

The survey, he added, shows that many owners already have their plans for modernization drawn up and more than half of them expect to carry out the prospective changes within 18 months after the end of the war, provided equipment and men are available. The major item specified by the building owners to meet competitive conditions of the future is that of elevator replacement, with general modernization work next and air conditioning third.

Joseph F. Reed

OREGON, ILL.—Joseph F. Reed, president and treasurer of Kol-Master Corporation, stoker manufacturers, died June 12 here.

Mr. Reed, aged 63, was born in Hollidaysburg, Pa. After being graduated from Purdue University in 1907, he became superintendent of Home Stove Works in Chicago. In 1912 he organized the Paragon Foundries Company, which in 1916 he moved to Oregon, Ill., and engaged principally in production of piano plates. In 1929, Mr. Reed organized the Paragon-Kol-Master Corporation and engaged in the manufacture of coal stokers. Later the company's name was changed to Kol-Master Corporation.



TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge	
						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"- 3"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	½"-30"				
Elbows	45° Long Radius	½"-24"	¾"-30"*	1"-12"	1"- 8"	4"-24"	3"-12"
Returns	180° Long Radius	1"-30"	1"-24"	1"-12"	3"- 8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-2½"	1½"-30"				
Returns	180° Extra Long Radius	¾"-24"	1"-2½"				
Tees	Straight	¾"-24"	¾"-24"	1"-12"	1"- 8"		
Tees	Reducing Outlet	x⅜-24x20	¾"-24"	¾"-12"	1"- 8"		
Reducers	Concentric & Eccentric	1"24"	x⅜-24x20		x⅜-12x10		
Caps		1"24"	1"-24"		1"- 8"		
Stub Ends	Lap Joint	1¼"-12"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header		1¼"-12"				
Saddles		1¼"-24"	2"-24"**				
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	¾"-24"	1¼"-24"				
Crosses	Straight	¾"-12"	¾"-24"				
Rings	Welding		¾"-12"				
Sleeves	Welding		2"-24"**				

*30" size short radius.

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".

Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

** Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"- 4"		¼"-3½"			
Socket Type	¼"-24"	¾"-24"	¾"-24"†	¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Reducing-threaded or slip-on	¾"-24"	1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—threaded		1"-24"					
Orifice—slip-on		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Orifice—welding neck		1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	
Long Welding Neck	1"-24"	1"-24"					

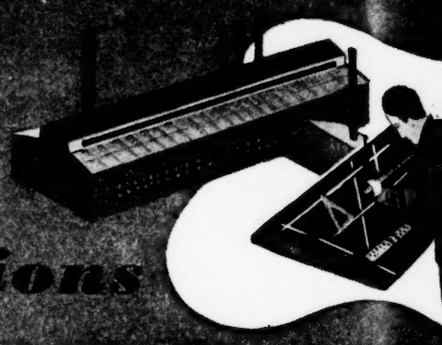
†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

The FIRST SEAMLESS WELDING FITTINGS 1ST AND STILL THE BEST

TUBE-TURN
TRADE MARK
Welding Fittings and Flanges

TUBE TURNS (Inc.) LOUISVILLE, 1, Ky. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, Seattle & San Francisco. *Distributors in principal cities.*

REVIEWS of TECHNICAL publications



HEATING AND AIR CONDITIONING

A 576-page book entitled "Heating and Air-Conditioning of Buildings," by Oscar Faber and J. R. Kell, published by The Architectural Press, 45 The Avenue, Cheam, Surrey, England. The book is the second edition of one first published in 1936. For the second edition the book has been thoroughly revised and much enlarged, and many chapters have been almost completely rewritten. The section on air conditioning has been considerably expanded, and includes a new psychrometric chart based on the tables of the Institution of Heating and Ventilating Engineers, while other chapters which have been extensively revised and enlarged include those on steam heating, and gas and electric heating. Entirely new chapters are included for the first time on high pressure hot water and ventilation.

The book is a combined textbook and handbook on the subjects covered by its title. Among the chapters of particular interest to American readers are those on Choice of Heating System, to which considerable attention is rightly paid and which includes detailed information on cost of operation; a chapter on Boiler Mountings and Chimney Calorifiers (heat exchangers); a chapter on Hot Water Heating including considerable information on panel (radiant) heating; extensive information on piping; a chapter on Heating and Hot Water Supply by Electricity, profusely illustrating the various methods in use in Great Britain for utilizing electric energy for these purposes; an extensive chapter on Heating by High Pressure Hot Water, which up to the present time is not well known in this country; and a chapter entitled "Running Costs of Heating Systems," which includes information on British degree-days.

Approximately 100 pages are given over to the subject of air conditioning, so that essentially the book is primarily a manual on heating.

In spite of the unfamiliarity of some of the illustrations of equipment and cost figures expressed in pounds, shillings and pence, the book is a valuable one for American engineers, particularly because the approach to many of the subjects is a fresh one for Americans.

Included is a comprehensive series of 87 tables, 350 line drawings, and 32 pages of half-tone plates, many of which illustrate installations carried out by the authors.

Size 6 x 9½ in., cloth bound. Available from the publishers direct, or through HEATING AND VENTILATING. Price 45s. (approximately $9 plus duty).

ARC WELDING

The first of three volumes to be published by The Hobart Brothers Company, following the original publication and distribution of a number of the design plates in loose leaf form. The book is a practical working mannal for the welder, manufacturer, engineer, and designer who are working and thinking of the advantages of arc welding in their present and post-war production. It is not a textbook, but an illustrated storehouse of information and detailed drawings showing how tubing, plate, sheet, standard steel sections, angles ard bars can be used to fabricate better, stronger, improved appearing products with arc welding and do it at substantially lower cost.

A complete work sheet in graph form is shown opposite each design plate. On these work sheets can be made notes, estimates and sketches as the design plate relates to the projected design. Important too is the Record form provided on the working sheet, that can be used to suggest and analyze applications of design ideas to the user's own products.

"Practical Design for Arc Welding," Vol. 1, by Robert E. Kinkead, consulting welding engineer; 100 design plates, cloth bound, 8¾ x 11½ in.; published by The Hobart Brothers Co., Hobart Square, Troy 1, Ohio. Price $3.50 per volume; 3-volume set, $10.

TEMPERATURE DROP IN DUCTS

One of the University of Illinois Engineering Experiment Station bulletins covering research on warm air heating systems, entitled "Temperature Drop in Ducts for Forced-Air Heating Systems." The studies reported had as their main object the study of the heat loss from galvanized-iron ducts carrying heated air, and to determine the resulting drop in temperature in the air flowing in the ducts. Further incidental objects were: (1) To determine the emissivity coefficients for radiation from the surface of commercial, galvanized-iron ducts; (2) to study the temperature stratification of the air flowing, and to determine the effect of such stratification on the heat loss and on the experimental methods required; (3) to correlate the heat transfer coefficients based on the air films inside and outside of the ducts with similar film coefficients given by other investigators; (4) to determine the effect of the velocity of the flowing air on the heat loss from the duct and on the drop in temperature of the air; (5) to derive curves giving the relations between the size and shape of the duct, the air velocity, and the temperature drop occurring in any given length of duct.

The studies were confined to uninsulated, horizontal, round, square and rectangular ducts of sizes and aspect ratios commonly used in forced-air heating systems. All ducts were freely suspended in the air without interference from joists or other nearby surfaces. The results are not directly applicable to vertical ducts nor to those concealed or installed between joists.

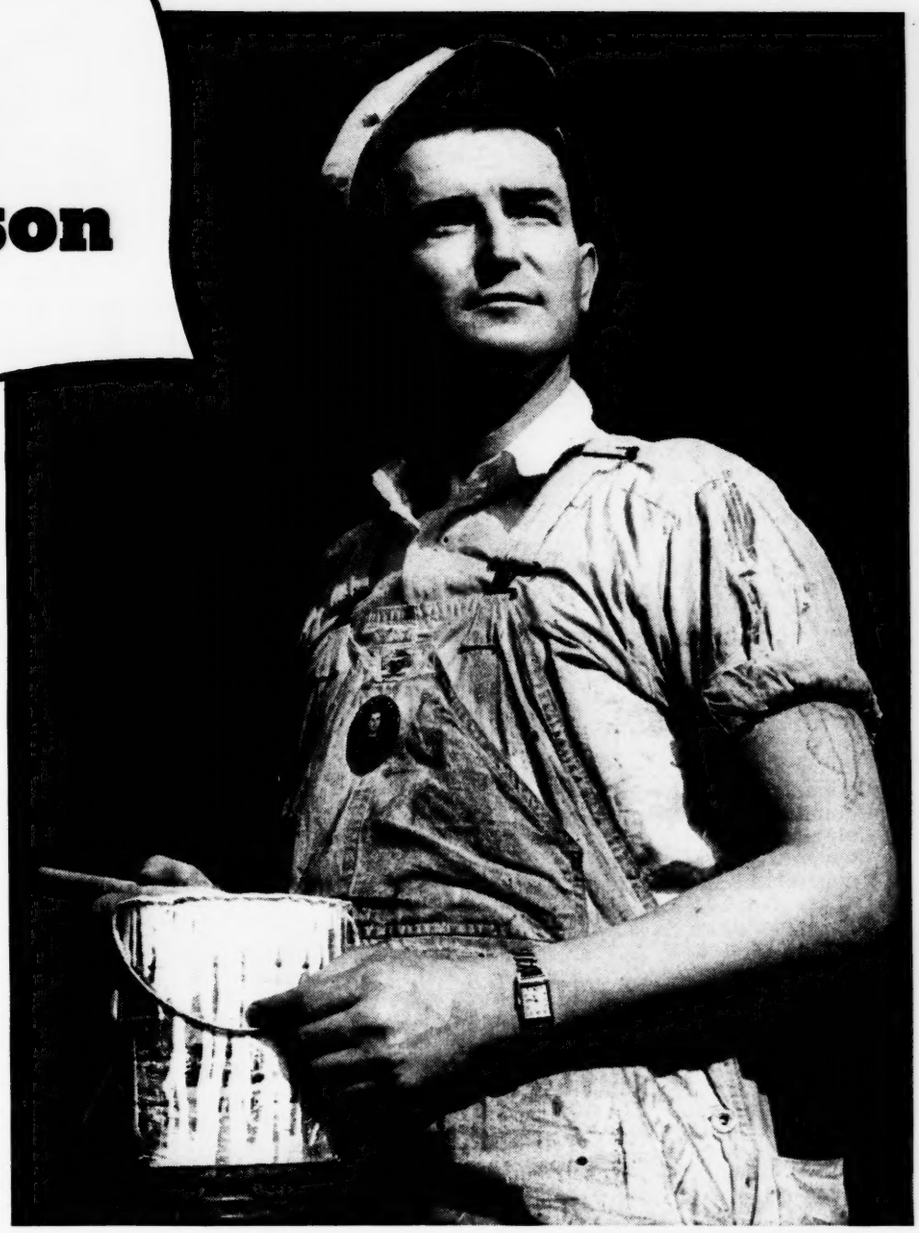
Among the results of the tests included in the report are working charts showing the rate of temperature drop in galvanized iron ducts as affected by duct diameters and air velocities and four charts showing temperature drop in uninsulated ducts for four different air velocities and for various equivalent diameters and air temperatures.

"Temperature Drop in Ducts for Forced-Air Heating Systems," by Alonzo P. Kratz, Seichi Konzo and Richard B. Engdahl, Engineering Experiment Station Bulletin Series No. 351, published by the University of Illinois, Urbana, Ill. Size 6 x 9 in., paper covered, 60 pages, price 65c.

BRIEF REVIEWS

VIBRATION—A 37-page engineering bulletin of Purdue University entitled "The Solution of Vibration Problems by Use of Electrical Models," a highly mathematical treatise based upon a thesis by Mr. Freberg in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Published by Purdue University, Lafayette, Indiana.

Meet Ev Jackson



You'd probably like knowing Everett C. Jackson. He was born in Illinois and now lives in Baltimore. He's thirty-four and married, and he holds a job at Bethlehem's ship-repair yard on Key Highway in Baltimore.

Soon after Pearl Harbor, Everett Jackson left the yard to join the Army. A first-aid man in the Medical Corps, he survived the sinking of the troopship on which he was bound for Guadalcanal, and later took part in the invasion of Rendova and New Georgia.

He served on New Georgia for twenty-seven days, under continuous bombing and strafing, and finally was badly wounded. After that, there were months in hospitals, then the Purple Heart and a medical discharge. Then the return to civilian life—and his old job with Bethlehem.

"Working here," says Everett Jackson, "is the next best thing to being out there fighting. I know they need the ships that I'm helping to repair at Key Highway. I only wish more people could understand how real that need is."

★ ★ ★

Like Everett Jackson, other veterans of World War II are joining, or rejoining, the Bethlehem production army in steady numbers. Over 11,000 ex-service men, nearly half of them former Bethlehem employees, have been employed by us in steel-making, in ordnance production, and in building and repairing ships.

To their jobs these veterans are bringing great resources of willingness, efficiency, and adaptability—and a marked desire to be treated by the same standards that apply to other civilians. Some of them are moving ahead to added responsibilities—to higher-skilled work or supervisory duties.

Their service in the armed forces is over. But they are heartened by realizing that through their jobs in steel plant or shipyard they are still helping directly to bring the war to an early and victorious end.

★ ★ BETHLEHEM STEEL ★ ★

WORLD'S LARGEST SHIPBUILDER

SECOND LARGEST STEEL PRODUCER

Shipbuilding and Ship Repair Yards . . . Quincy, Hingham, East Boston, Mass. . . . Staten Island, Brooklyn, N. Y. . . . Hoboken, N. J. . . . Baltimore, Sparrows Point, Md. . . . San Francisco, Alameda, San Pedro, Calif.

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Degree-Days for May, 1944

HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

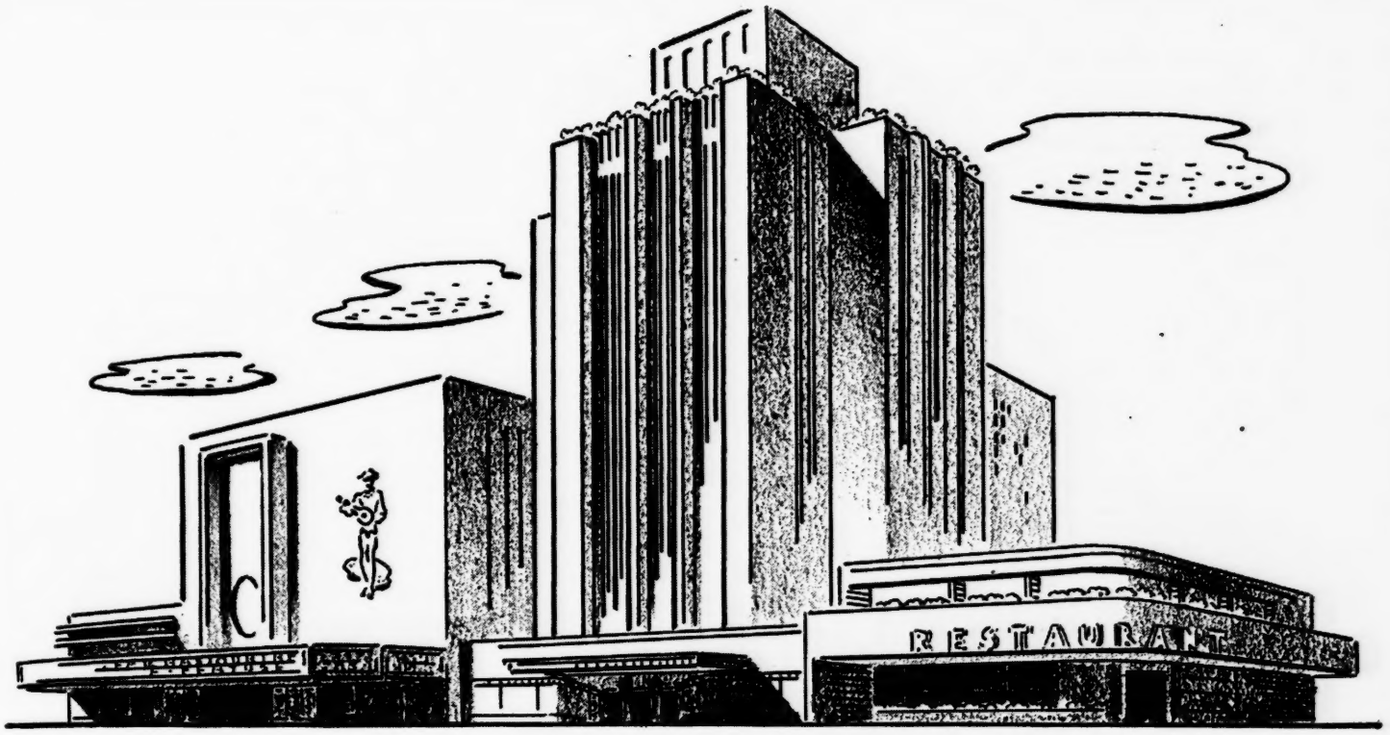
City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, May, 1944	Degree-Days, May, 1943	Degree-Days, May, Normal	Season, 9/1/43-5/31/44	Season, 9/1/42-5/31/43	Season, Normal, 9/1-5/31	Normal, 9/1-6/30
Abilene, Texas	18	37	0	2530	2338	2061	2061
Albany, New York	112	234	183	7122	7343	6580	6580
Albuquerque, New Mexico	85	60	40	4860	3657	4298	4298
Alpena, Michigan	349	459	465	7817	8242	8127	8299*
Anaconda, Montana	444	629	517	7729	8052	8010	8357**
Asheville, North Carolina	62	64	71	4214	4151	4232	4232
Atlanta, Georgia	34	10	0	2939	2875	2890	2890
Atlantic City, New Jersey	139	185	220	4954	4867	5176	5176
Augusta, Georgia	12	1	0	2271	2179	2161	2161
Baker, Oregon	369	534	431	6677	6841	6950	7163
Baltimore, Maryland	25	63	22	4445	4409	4533	4533
Billings, Montana	220	436	316	6366	7215	7059	7119
Binghamton, New York	104	235	254	6925	6834	6808	6808
Birmingham, Alabama	43	1	0	2916	2478	2352	2352
Bismarck, North Dakota	200	406	338	8019	9359	9147	9192
Block Island, Rhode Island	241	354	378	5767	5984	5689	5788
Boise, Idaho	224	345	236	5835	5657	5552	5552
Boston, Massachusetts	121	243	245	5986	6156	6045	6045
Bozeman, Montana	373	575	471	7638	8058	8195	8521**
Buffalo, New York	130	411	335	6904	7275	6810	6822
Burlington, Vermont	169	339	273	8041	8208	7511	7514
Butte, Montana	465	641	502	8320	8690	7926	8272
Cairo, Illinois	58	21	0	3961	3880	3909	3909
Canton, New York	147	307	334	8055	8408	8020	8020
Charles City, Iowa	169	330	224	7331	8146	7588	7588
Charleston, South Carolina	4	2	0	1874	1911	1769	1769
Charlotte, North Carolina	19	23	0	3125	3079	3120	3120
Chattanooga, Tennessee	48	15	0	3587	3266	3118	3118
Cheyenne, Wyoming	393	557	446	7345	7004	7340	7466
Chicago, Illinois	136	301	242	6381	6849	5957	5957
Cincinnati, Ohio	58	102	0	4927	5102	4684	4684
Cleveland, Ohio	108	240	220	5986	6089	6155	6155
Columbia, Missouri	100	126	22	5220	5057	4922	4922
Columbia, South Carolina	13	4	0	2474	2379	2364	2364
Columbus, Ohio	49	126	87	5357	5517	5398	5398
Concord, New Hampshire	183	323	298	7624	7797	7299	7353
Concordia, Kansas	131	232	65	5657	5545	5315	5315
Dallas, Texas	18	7	0	2436	2321	2256	2256
Davenport, Iowa	131	233	118	6185	6622	6289	6289
Dayton, Ohio	79	161	81	5771	5576	5264	5264
Denver, Colorado	226	387	267	5794	5282	5874	5874
Des Moines, Iowa	139	249	118	6406	6718	6384	6384
Detroit, Michigan	144	275	226	6561	6790	6490	6490
Devils Lake, North Dakota	267	497	424	9053	10282	9874	9970
Dodge City, Kansas	128	228	47	5541	4939	5035	5035
Dubuque, Iowa	148	272	149	6698	7233	6790	6790
Duluth, Minnesota	457	464	521	9015	9629	9267	9443
Eastport, Maine	438	514	543	7856	8060	7941	8520**
Elkins, West Virginia	59	173	177	5780	5627	5697	5697
El Paso, Texas	10	5	0	2812	2205	2428	2428
Ely, Nevada	432	470	—	7771	6565	—	—
Erie, Pennsylvania	134	303	257	6351	6442	6273	6273
Escanaba, Michigan	357	468	490	8039	8779	8608	8771*
Evansville, Indiana	83	51	0	4776	4777	4244	4244
Fort Smith, Arkansas	43	15	0	3247	3090	3147	3147
Fort Wayne, Indiana	128	239	130	6575	6722	5925	5925
Fort Worth, Texas	16	11	0	2385	2322	2148	2148
Fresno, California	26	21	0	2564	2419	2334	2334
Galveston, Texas	2	0	0	1163	1046	1016	1016
Grand Junction, Colorado	128	170	118	5439	4735	5548	5548
Grand Rapids, Michigan	175	291	174	6573	6873	6535	6535
Green Bay, Wisconsin	226	322	322	7592	8181	7825	7825
Greensboro, North Carolina	29	50	0	4055	3873	3529	3529
Greenville, South Carolina	23	20	0	3168	3125	3380	3380
Harrisburg, Pennsylvania	30	115	90	5487	5428	5375	5375
Hartford, Connecticut	86	194	202	6284	6434	6036	6036
Hatteras, North Carolina	3	21	0	2724	2539	2571	2571
Havre, Montana	221	410	369	7125	8398	8556	8700
Helena, Montana	359	499	402	7702	8452	7663	7898
Houston, Texas	4	0	0	1304	1212	1157	1157
Huron, South Dakota	178	387	267	7723	8410	8004	8004
Indianapolis, Indiana	82	158	59	5383	5776	5298	5298
Kansas City, Missouri	114	153	6	5218	5064	4956	4956
Kewanee, Illinois	127	279	133	6535	7042	6129	6139
Knoxville, Tennessee	42	33	0	3709	3696	3670	3670
La Crosse, Wisconsin	161	327	183	7366	8113	7322	7322
Lander, Wyoming	348	476	428	8373	7500	7812	7947

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 92]



Boiler Plant...

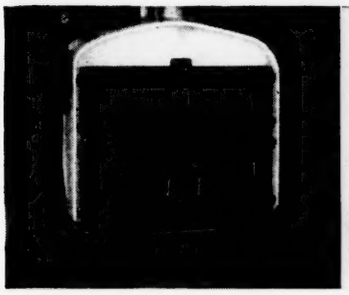
FOR BUILDINGS OF PUBLIC PATRONAGE

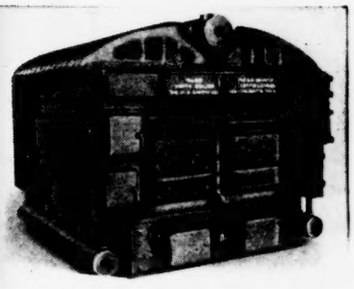
Theatres, hotels, restaurants . . . all are absolutely dependent upon public patronage. A constant stream of traffic is essential if overhead expenses are to be met and a profit made.

Selection of heating equipment for this type of building is doubly important. Not only is the "cost of use" (i.e. — fuel expense, plus maintenance, plus amortization) a number one annual item, but in addition failure of heat for even one day will result in a serious loss of revenue as well as great inconvenience. That is why so many H. B. SMITH cast-iron boilers are installed in these buildings . . . because H. B. SMITH boilers not only operate at high efficiencies with *any* fuel but at a minimum of maintenance expense. Moreover, being of header type construction, the possibility of mid-season heating failure is minimized as each section is in fact an independent boiler which can be disconnected with no interruption of service should an accident occur.

It is our prediction that the boiler plants heating tomorrow's theatres, hotels and restaurants will closely resemble the best installations of 1941. Specifiers and installers who will be continually judged by the operation of the boilers they select will do well to base their choice on a known quantity of performance... H. B. SMITH.

44 MILLS **60 SMITH**





H.B. *Smith*

CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INC. • WESTFIELD, MASS.

Branch Offices and Sales Representatives in Principal Cities

Degree-Days for May, 1944 (Concluded)

HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, May, 1944	Degree-Days, May, 1943	Degree-Days, May, Normal	Season, 9/1/43-5/31/44	Season, 9/1/42-5/31/43	Season, Normal, 9/1-5/31	Normal, 9/1-6/30
Lansing, Michigan	192	322	229	7195	7369	7048	7048
Lewiston, Maine	247	321	344	8060	7881	7662	7707
Lincoln, Nebraska	152	234	99	6120	6108	5999	5999
Little Rock, Arkansas	43	1	0	3138	3045	2811	2811
Livingston, Montana	353	530	405	6819	7202	7043	7205
Los Angeles, California	98	44	90	1407	1125	1504	1504
Louisville, Kentucky	59	47	0	4376	4505	4180	4180
Lynchburg, Virginia	24	57	0	3955	3916	3980	3980
Macon, Georgia	21	1	0	2384	2244	2201	2201
Madison, Wisconsin	171	330	236	7244	7818	7429	7429
Marquette, Michigan	387	468	496	8111	8666	8464	8693*
Memphis, Tennessee	48	3	0	3252	3160	2950	2950
Meridian, Mississippi	28	0	0	2385	2179	2160	2160
Milwaukee, Wisconsin	261	380	350	7254	7649	7206	7245
Minneapolis, Minnesota	193	321	236	7617	8550	7850	7850
Modena, Utah	356	310	350	6690	5837	6520	6562
Montgomery, Alabama	25	0	0	2066	1922	1884	1884
Nantucket, Massachusetts	244	355	384	5730	5953	5834	5957
Nashville, Tennessee	54	18	0	3720	3640	3507	3507
New Haven, Connecticut	138	193	223	6111	5948	5895	5895
New Orleans, Louisiana	2	0	0	1234	1205	1024	1024
New York, New York	93	162	155	5364	5308	5347	5347
*Nome, Alaska	1461	1317	1443	11545	12118	12085	14580**
Norfolk, Virginia	6	32	0	3426	3190	3350	3350
North Head, Washington	398	445	422	4314	4556	4693	5452**
North Platte, Nebraska	153	323	199	6408	6096	6366	6366
Oakland, California	218	194	205	2868	2726	2870	3143**
Oklahoma City, Oklahoma	55	105	0	3667	3559	3613	3613
Omaha, Nebraska	148	240	84	6386	6364	6131	6131
Oswego, New York	220	374	357	7134	7274	7025	7088
Parkersburg, West Virginia	36	98	53	5041	4956	4775	4775
Peoria, Illinois	131	228	121	6268	6337	6109	6109
Philadelphia, Pennsylvania	41	115	68	4842	4914	4855	4855
Phoenix, Arizona	0	0	0	1519	1013	1405	1405
Pittsburgh, Pennsylvania	38	130	78	5368	5325	5235	5235
Pocatello, Idaho	304	390	332	6993	6371	6595	6655
Portland, Maine	310	377	366	7727	7786	7137	7218
Portland, Oregon	208	266	245	3983	4050	4379	4469
Providence, Rhode Island	93	203	251	5783	5958	6015	6015
Pueblo, Colorado	183	287	186	5997	5206	5514	5514
Raleigh, North Carolina	17	29	0	3440	3210	3234	3234
Rapid City, South Dakota	249	421	344	7216	7371	7088	7118
Reading, Pennsylvania	38	121	96	5305	5340	5389	5389
Redding, California	76	50	0	2646	2506	2451	2451
Reno, Nevada	310	321	366	5951	5186	5802	5892
Richmond, Virginia	14	60	0	3931	3807	3695	3695
Rochester, New York	135	277	260	7062	7130	6732	6732
Roseburg, Oregon	262	266	267	4165	3793	4314	4428
Roswell, New Mexico	38	41	0	3644	2937	3484	3484
Sacramento, California	73	43	53	2597	2476	2653	2653
St. Joseph, Missouri	126	190	16	5582	5516	5161	5161
St. Louis, Missouri	94	93	0	4717	4676	4585	4585
Salt Lake City, Utah	186	304	236	6126	5499	5555	5555
San Antonio, Texas	12	0	0	1683	1408	1202	1202
San Diego, California	76	28	115	1360	1111	1639	1645
Sandusky, Ohio	115	220	183	6048	6230	6208	6208
San Francisco, California	255	224	264	2454	2446	2681	3264**
Sault Ste. Marie, Michigan	346	521	502	8742	7940	8950	9285**
Savannah, Georgia	3	0	0	1531	1556	1490	1490
Scranton, Pennsylvania	69	194	171	6329	6393	6129	6129
Seattle, Washington	262	322	316	4101	4331	4695	4934**
Sheridan, Wyoming	279	466	403	7185	7310	7888	8008
Shreveport, Louisiana	19	0	0	2243	2106	1938	1938
Sioux City, Iowa	161	285	164	7010	7287	6898	6898
Spokane, Washington	262	393	285	6155	6448	6274	6355
Springfield, Illinois	105	146	56	5458	5522	5373	5373
Springfield, Missouri	97	111	12	4839	4680	4428	4428
Syracuse, New York	129	261	267	7137	7205	6881	6893
Tacoma, Washington	304	353	332	4557	4665	4883	5181**
Terre Haute, Indiana	88	111	0	5218	5282	4872	4872
Toledo, Ohio	131	251	180	6611	6619	6077	6077
Topeka, Kansas	116	165	34	5183	5081	4969	4969
Trenton, New Jersey	54	136	81	5327	5343	4933	4933
Utica, New York	140	283	253	7574	7471	6796	6796
Valentine, Nebraska	199	381	273	7270	7187	7039	7039
Walla Walla, Washington	158	255	171	4993	4935	4808	4808
Washington, D. C.	15	73	25	4456	4376	4626	4626
Wichita, Kansas	89	186	0	4784	4839	4673	4673
Williston, North Dakota	229	439	362	8050	9418	9269	9323
Winnemucca, Nevada	281	322	324	6336	5449	6274	6427**
Yakima, Washington	171	268	186	5385	5690	5599	5599

*Includes August. **Includes July and August.

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.

PROPERTIES OF "FREON-22"

The purpose of this sheet is to present in condensed form information on the properties and characteristics of the refrigerant "Freon-22." Data are taken from a bulletin by R. J. Thompson and W. W. Rhodes of Kinetic Chemicals, Inc., producers of "F-22," and owners of the copyright on the name "Freon-22."

"Freon-22" is monochlorodifluoromethane, $CHCLF_2$, whose boiling point at 1 atmosphere is —41.44F. It is non-toxic, with no flame propagation as high as 212F. The vapor is odorless at concentrations of less than 20% by volume in air.

Where Used. "F-22" is used in creating relatively low temperatures by reciprocating type compressors with auxiliary refrigerating apparatus. It should be used only in compressors designed for its use where, by its employment one can effect more efficient and advantageous operation, such as at those low temperatures where sufficiently low back or vapor pressures cannot be produced with higher boiling point and lower pressure refrigerants without complicated machine design.

Comparisons. Low temperatures are obtained in two ways:

(1) Operate a compressor employing a refrigerant such as "Freon-12" at low back pressure; *i.e.* causing the refrigerant to boil at a lower temperature than normal.

(2) Select a refrigerant such as "Freon-22," which has a lower boiling point than "Freon-12," so that the required low temperature may be obtained with a relatively high back pressure.

The penalty of low back pressure is, of course, the great loss of volumetric efficiency incurred in compressing a rarefied gas, and it is desirable in low temperature refrigeration to use a refrigerant of low boiling point, such as "Freon-22," in order that the back pressure be higher and the gas for compression be denser.

As an example, a reciprocating type compressor using "Freon-12," which produces a temperature of —40F within the evaporator, must handle the gas at a negative pressure of approximately 11 inches of mercury. The same compressor using "Freon-22," operating at the same temperature of —40F will handle the gas at approximately 1 pound gage, or at the same back pressure of 11 inches a temperature of —58.5F will be obtained. Thus, it will readily be seen that lower temperatures can be obtained at the same back pressure without sacrificing volumetric efficiency or providing for increased compressor displacement when "Freon-22" is used.

In Table 1 will be found refrigeration ton comparative data of "Freon-22," "Freon-12," ammonia, and methyl chloride, with respect to the theoretical displacement of the compressor, quantities of liquid refrigerant to be vaporized, high and low side pressures of the system, temperatures of compression, etc. The values for the ton conditions (200 Btu per minute) are for an evaporator temperature of —60F and a temperature of 80F in the saturated portion of the condenser, not providing for the superheat of vapor or the subcooling of the liquid refrigerant.

In Table 1 note the higher back pressure permitted by the use of "Freon-22" and accounting for the improvement in volumetric efficiency. Under the evaporator and condenser conditions given in Table 1, the compression ratio will be 18.05 to 1 for "Freon-22," 27.6 to 1 for ammonia, 18.37 to 1 for "Freon-12," and 22.7 to 1 for methyl chloride, making it advisable in certain cases to provide for two or three stages of compression.

TABLE 1.—COMPARISON OF PROPERTIES OF "FREON-22," "FREON-12," AMMONIA AND METHYL CHLORIDE, AND UNIT VALUES PER TON (200 BTU) PER MINUTE (UNIT VALUES BASED ON —60F EVAPORATOR TEMPERATURE AND 80F IN SATURATED PORTION OF CONDENSER).

	"Freon-22"	Ammonia	"Freon-12"	Methyl Chloride
Chemical formula	$CHCLF_2$	NH_3	CCL_2F_2	CH_3CL
Molecular weight	86.48	17.03	120.9	50.48
Boiling point, 1 atm, F	—41.44	—28.0	—21.6	—10.76
Melting point, 1 atm, F	—256.0	—107.86	—252.0	—144
Critical temperature, F	204.8	271.2	232.7	289.4
Critical pressure, lb per sq in abs	716	1651.0	582	968.7
Gage pressure lb per sq in, 80F	145.0	138.3	84.06	71.56
Gage pressure lb per sq in —60F	*11.89	*18.6	*19.00	*22.19
Saturated pressure at 80F, (head pressure) lb per sq in gage	145	138.3	84.06	71.56
Saturated pressure at —60F (back pressure) inches of mercury vacuum	*11.89	*18.6	*19.00	*22.19
Heat content, saturated vapor —60F, Btu per lb	98.10	589.6	71.13	187.74
Heat content, liquid, 80F, Btu per lb	34.09	132.0	26.28	44.36
Refrigerating effect, Btu per lb	64.01	457.6	44.85	143.38
Pounds of refrigerant per minute, per ton	3.125	.437	4.46	1.39
Cubic foot of liquid per lb, 80F	.0135	.02668	.0123	.01764
Cubic inches liquid refrigerant evaporated per minute	72.8	20.6	94.8	42.4
Cubic feet vapor per lb, —60F	5.452	44.73	6.516	22.09
Cubic feet piston displacement per minute	17.02	19.55	29.05	30.7
Btu refrigeration per cu ft displacement	11.75	10.23	6.89	6.52
Compression ratio	18.05	27.6	18.37	22.7
Temperature of compression, F	185.7	385	120.1	294.6

*Inches mercury below atmosphere.

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PROPERTIES OF "FREON-22"

TABLE 2.—SATURATED VAPOR PRESSURE OF "FREON-22" POUNDS PER SQUARE INCH GAGE.

Temp., F	Vapor Pressure, Lb. per Sq. In. Gage
—150	*29.4
—140	*29.0
—130	*28.5
—120	*27.7
—110	*26.6
—100	*25.1
—90	*23.0
—80	*20.2
—70	*16.6
—60	*11.9
—50	*6.0
—40	0.6
—30	5.0
—20	10.3
—10	16.6
0	24.2
10	33.0
20	43.3
30	55.3
40	69.0
50	84.7
60	102.5
70	122.5
80	145.0
90	170.1
100	197.9
110	228.7
120	262.6

*Inches of mercury below one atmosphere.

TABLE 3.—VISCOSITY OF "FREON-22"

Temp., F	Viscosity Centipoises x 10^3	
	Vapor	Liquid
—40	1.05	35.9
—20	1.09	3.16
0	1.13	29.1
20	1.18	27.1
40	1.22	25.6
60	1.26	24.3
80	1.30	23.2
100	1.33	22.3
120	1.37	21.4
140	1.41	20.7
160	1.45	20.1
180	1.48	19.5
200	1.52	
220	1.56	
240	1.59	

Line and Equipment Sizing. The item "Cubic inches liquid refrigerant evaporated per minute" (per ton) in Table 1 will assist in determining line sizes and regulating valve orifice diameter.

There is advantage in circulating large volumes of liquid refrigerant through the regulating valve orifice, as the greater volume permits of less sensitive, more accurate, and more positive operating and regulating mechanisms with less critical adjustment. Refrigerants with high Btu refrigerating effects are not desirable for the smaller commercial or industrial installations requiring close temperature control, due to the small volume of liquid refrigerant in the system and the difficulty encountered in accurately metering or regulating the flow of such small quantities of liquid through the orifice.

Values for the item "Cubic feet piston displacement per minute" (per ton) in Table 1 indicate that with "Freon-22" in existing equipment, it will be possible to either increase the refrigeration capacity of a "Freon-12" compressor approximately 71% with the same bore, stroke, and speed, or to maintain the same refrigeration capacity by reducing the speed of the "Freon-22" charged "Freon-12" compressor approximately 44½%. Obviously, if the same bore, stroke, and speed are used with a "Freon-22" compressor, a larger condenser and motor will be required to take care of the resulting higher refrigeration capacity.

Vapor Pressure. Table 2 gives values for the saturated vapor pressure of "Freon-22" at various temperatures. The freezing point of "Freon-22" is —256F.

Lubrication. For extremely low temperature work lubrication may become a problem, and the following three solutions are suggested:

(1) Use an oil as low in viscosity as is practical for satisfactory compressor operation.

(2) Use an oil which has been dewaxed or degummed at a sufficiently low temperature so that any remaining wax will not be precipitated out of the oil at the lowest operating temperature, when the oil is in solution with liquid "Freon-22."

(3) Install an oil separator between the compressor and the condenser and as close to the cylinder head as possible, so as to prevent the oil containing wax passing through the condenser, receiver, liquid line, expansion valve, and into the low temperature evaporator.

Solubility of Water in "Freon-22." The solubility of water in "Freon-22" is approximately eight times higher than the solubility of water in "Freon-12." Thus, there should be no separation of water from "Freon-22" at temperatures as low as —112F, providing, of course, that the "Freon-22" does not contain more than .0025% moisture by weight, which is the maximum contained in "Freon-22" when obtained from the manufacturer.

Viscosity. Table 3 gives values of viscosity at various temperatures.

Safety. "Freon-22" vapors in all concentrations are non-irritating to the eyes, nose, throat, lungs, or skin. Gas masks or refrigerant absorbent materials are not required when handling "Freon-22," or any other "Freon" refrigerant.

A leak of "Freon-22" vapor can be definitely located by means of a Halide torch or lamp, by the same method used for other of the "Freon" fluorine refrigerants.

Further Information. For more complete information or advice, communicate with Kinetic Chemicals, Inc., Wilmington 98, Delaware.

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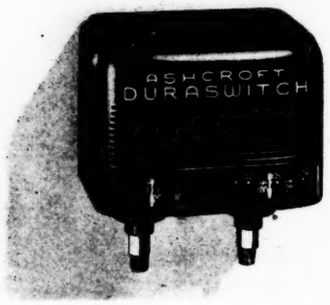
NEWS OF EQUIPMENT AND MATERIALS

Ashcroft Duraswitch

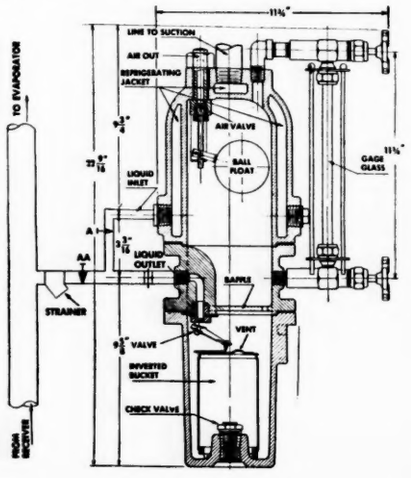
NAME — Ashcroft Duraswitch type E-100 and E-200.
PURPOSE—Series E-100 is a pressure switch; E-200 for both pressure and temperature application as a pressure control and pressure gauge combination or temperature control and



thermometer combination in single or duplex types.
FEATURES — Duraswitch is a sturdy, dependable switch in combination with Ashcroft gauge. Gauge has slide rule dial easily readable for accurate adjusting of the switch to control point. This combination saves space on equipment, eliminates extra fittings, saves on installation, while contributing improved appearance.
MADE BY—*Manning, Maxwell & Moore, Bridgeport, Conn.*

Refrigerant Purgers

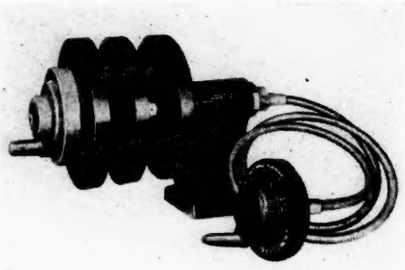
NAME—Armstrong refrigerant purgers, model 253.
PURPOSE—Especially recommended for systems with low suction pressures.
FEATURES—As shown in accompanying diagram, valve controlled by inverted bucket discharges liquid refrigerant to liquid supply line in-



stead of directly to refrigerating jacket. Thus, pressure differential across valve is only 1 or 2 lb. which keeps wear on valve and seat at minimum. This model does not replace previous models, but is especially recommended for systems with low suction pressures. Also available in a forged steel model.
LITERATURE AVAILABLE—Bulletin 160.
MADE BY—*Armstrong Machine Works, Three Rivers, Mich.*

American Speed-Jack

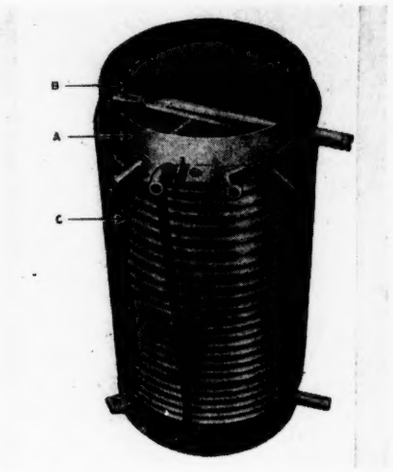
NAME—American Speed-Jack.
PURPOSE—A variable-speed transmission for drives up to 1 hp.
FEATURES—Remote control through a compact flexible shaft which makes it possible to mount the unit anywhere in or on the machine and to place the control in a safe location handy to the operator. Movement of the flanges is controlled mechanically and not by belt-pull, so that device



may be mounted either vertically, horizontally or in any other position. Utilizes V-belts to provide stepless control of speed through a 3 to 1 ratio. Design of control mechanism eliminates ratio-creep and assures constant belt alignment regardless of the unit's mounted position, belt wear or belt stretch. Plastic flanges, steel-faced.
MADE BY—*The American Pulley Co., 4200 Wissahickon Avenue, Philadelphia 29, Pa., Department 202.*

Water Coolers

NAME—Strata-Flo water coolers.
PURPOSE—Drinking water cooler designed to eliminate warm-up and wet systems.
FEATURES—Shell of storage tank *A* is between vertical interior fins *B* and external refrigerant coil *C*. Continuous cooling action on body of water in storage tank is transmitted from refrigerant coil through shell to these fins. Fins prevent swirling action and confine incoming warm water supply to upper levels, eliminating mixture with water already cooled in lower portion of tank, thus minimizing warm-up. Since refrigerant can never come in direct contact with water, or vice-versa, danger of wet system is eliminated and control is non-critical. This permits use of the simplest types of controls, con-

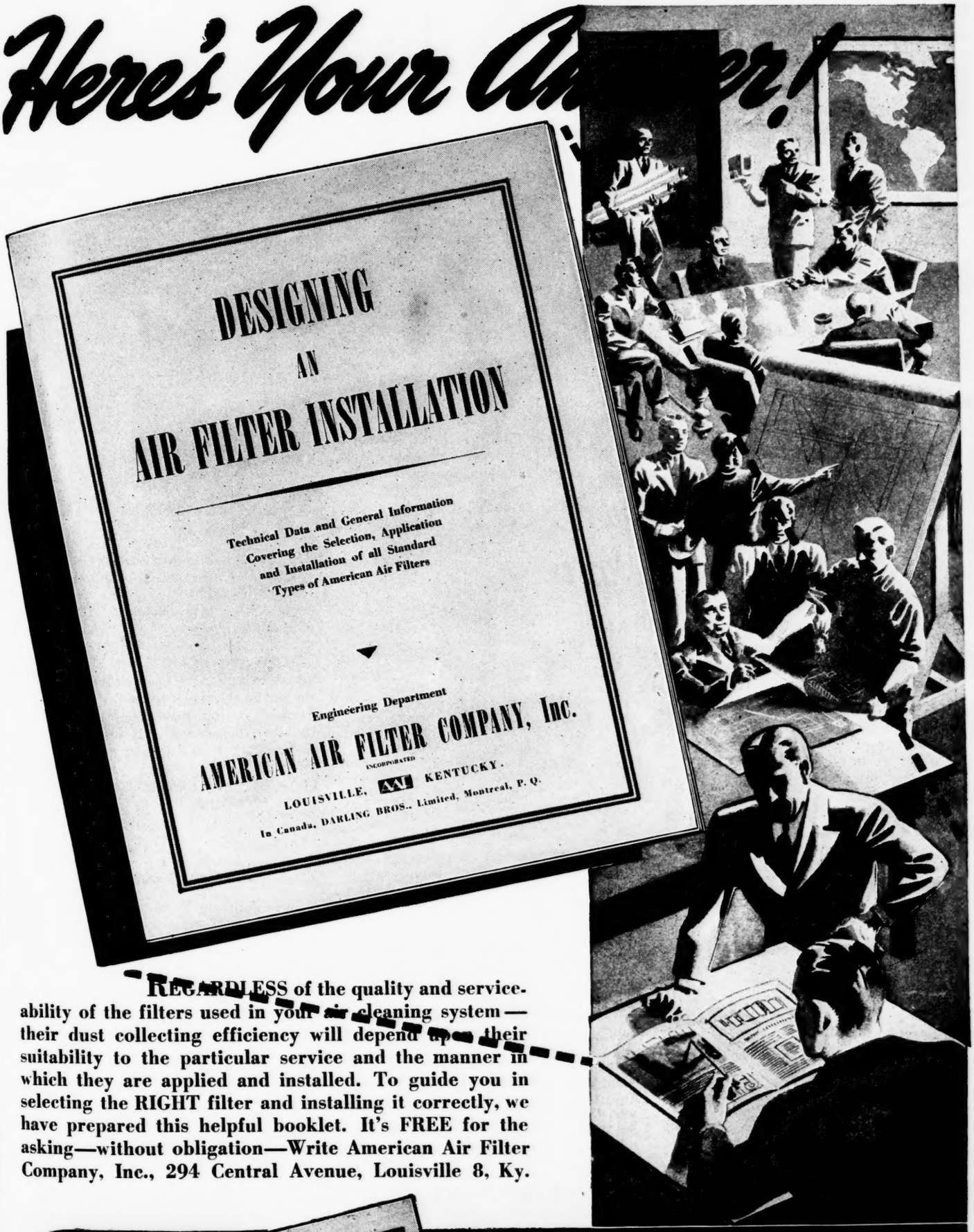


sisting of an automatic expansion valve and external adjustable thermostatic switch.
SIZES AND CAPACITIES—Cabinet models available in 3½, 7, and 12½ gallon capacities.
MADE BY—*Drayer & Hanson, Inc., 738 E. Pico St., Los Angeles 21, Calif.*

Fiberglas XM-PF Sheets

NAME—Fiberglas type XM-PF.
PURPOSE—Fiberglas sheets now being used in cabins of certain U. S. war planes to provide insulation against extreme cold of stratosphere and to deaden fatigue-causing sound.
FEATURES — Particularly on long flights, it has been found that a high sound level within the plane is a major factor contributing to crew fatigue. With planes operating at altitudes where temperatures of —60F are commonly encountered, insulation is necessary to reduce the burden on heating equipment, and permit lighter equipment to be used. Sheets are incombustible and said to be lightest inorganic material commercially available for sound-proofing and insulation of planes. **Sheets gain less than 1% of their own weight from moisture in the air when subjected to temperatures of 125F and to 90% relative humidity, and so do not cause dead-load of plane to increase when it is flying through humid air.**
MADE BY — *Owens-Corning Fiberglas Corp., Nicholas Bldg., Toledo, Ohio.*

Here's Your Answer!



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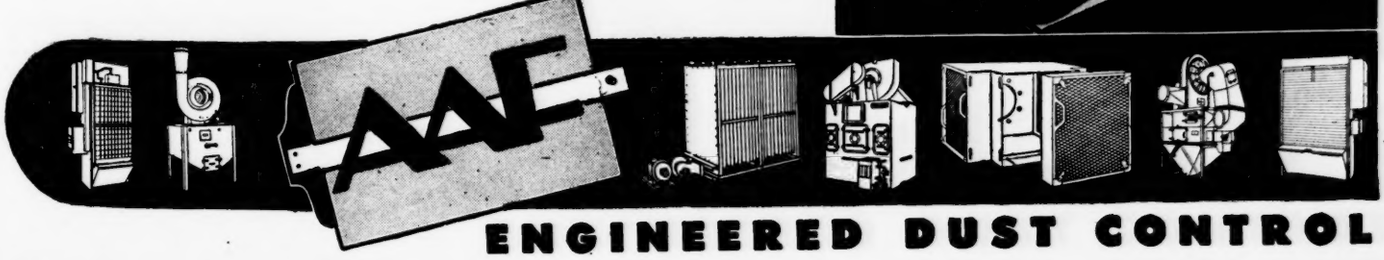


ENGINEERED DUST CONTROL

Conduit Lock Seam

NAME — Reinforcing lock seam on helical corrugated conduit housing for Ric-wil prefabricated insulated pipe units.

PURPOSE—To assure a permanently pressure tight waterproof structure.

FEATURES—Automatic machine weld is made at factory before galvanizing. Drive couplers (see HEATING AND VENTILATING, June, 1944), available for connecting sections with minimum of field labor.

MADE BY—*The Ric-wil Co., 1572 Union Commerce Bldg., Cleveland, Ohio.*

Photographic Records

NAME — Microcopy Translite Hi-Reduction process.

PURPOSE—For copying drawings or other records on microfilm; also a viewer for magnifying and reading such drawings.

FEATURES—Microcopy, being a photographic record, can be used with copies on tracing paper, cloth or film and including pencil drawings. As many film duplicates as desired may be made. Advantage claimed is that enormous quantities of drawings on microfilm can be stored in fireproof safes at a saving from 90 to 98% of filing space. Duplicates can be reproduced on film paper, tracing paper or cloth in cases of destruction of originals. For reading negatives a Microcopy multiple-magnification viewer, illustrated, is supplied in various models. Viewer operates on motion picture projector principle, easily controlled from a panel.

LITERATURE AVAILABLE—Bulletin entitled "Hold Everything."

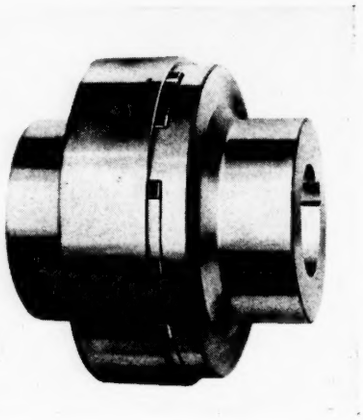
MADE BY—*Microcopy Corp., 2800 West Olive Ave., Burbank, Calif.*

Flexible Shaft Coupling

NAME — L-R type C flexible shaft coupling.

PURPOSE—A coupling that provides protection for operator against catching of clothing or incautious handling.

FEATURES—Essential feature of protection is outside steel collar which holds load cushions in place. An extension of this collar which encircles coupling, safeguards material and fingers from heads of bolts that secure load cushion retainer. Boltheads are concealed, yet easily and conveniently reached. Types are available for directly attaching to flywheel, also drum types and others for rapid disassembly without disturbing drive or driven equipment, etc.



SIZES AND CAPACITIES—Designed for heavy duty services from 4.60 to 806 hp at 100 rpm.

LITERATURE AVAILABLE—Bulletin, on request.

MADE BY—*Lovejoy Flexible Coupling Co., 5009 W. Lake St., Chicago 44, Ill.*

Lincoln Calculator

NAME—Welding Preheat and Interpass Temperature Calculator.

PURPOSE—Circular slide rule for determining welding preheating and interpass temperatures of steels in those few cases where experience indicates the need for preheating to obtain best welding results.

FEATURES—Calculator is 6¼ in. in diameter and consists of four movable sections of heavy cardboard stock. Complete instructions in the form of six simple steps are printed on the outside sections. Although most steels are readily weldable and require no preheating because of low carbon and alloy content, this calculator will serve as a convenient guide in instances where steels have a higher content of carbon and other alloys and require preheating to minimize the tendency toward excesssive hardening and possible cracking of the base metal adjacent to the weld. Available for twenty-five cents, postpaid.

MADE BY—*The Lincoln Electric Company, Cleveland, Ohio.*

Johnson Separator

NAME—Johnson type SA separator.

PURPOSE—Self draining compressed air separator which is said to eliminate need for external traps or uncertainties of a manual drain.

FEATURES—Has complete trap mechanism built in, which releases from the separator, automatically, water and oil removed from compressed air. Operation in removing water, dirt and oil from compressed air is identical with standard Johnson separators. It employs the two principles of expansion and change of direction of flow abruptly many times, and surrendering the remaining particles of foreign matter.

SIZES AND CAPACITIES—In one size; capacities of 80 or 160 cubic feet of free air per minute at 90 lb pressure. Smaller size has inlets of ¾, 1, or 1¼ in.; larger has inlets of 1½ or 2 in.

MADE BY—*Johnson Corp., 877 Wood Street, Three Rivers, Mich.*

DUST-STOPS* HELP PROTECT BLOOD PLASMA IN PHARMACEUTICAL LABORATORIES

In the laboratories of John Wyeth & Brother, Inc., Reichel Division at Kimberton, Pa., blood donated by civilians is converted into dried blood plasma for the Armed Forces. In an important stage of the process (illustrated above) when bottles are open to the air, Fiberglas* Dust-Stop Air Filters are privileged to play a vital part.

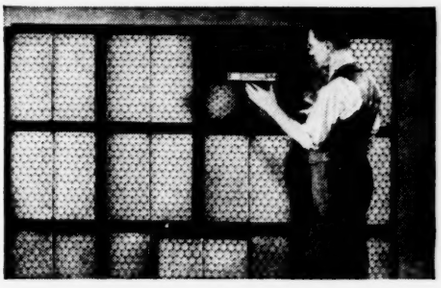
Where Clean Air Helps Save Lives

Here, in the laboratory cubicles, every precaution is taken to prevent contamination of the precious blood plasma. Essential air for ventilation enters through the Dust-Stop Filters just above the door of the cubicle. The Dust-Stops filter out dust and dust-borne micro-organisms which might contaminate the plasma to be injected into the veins of wounded men.

Dust-Stops Have Definite Advantages

The Dust-Stop filtering medium is Fiberglas . . . glass fibers interlaced to form a uniform pack faced with a metallic grille. The fibers are round and smooth, offering little resistance to air flow. Being glass, they are nonabsorptive. These fibers are surfaced with a nonevaporating, dust-catching adhesive with extraordinary holding and wetting power (an exclusive Dust-Stop feature); each particle of trapped dust becomes quickly soaked and acts as a wick to capture other dust particles. Thus, the Dust-Stop maintains its efficiency until it becomes heavily coated with dust—then it can be easily, quickly and inexpensively replaced.

Because of their ready adaptability to practically every problem of dust control, Dust-Stops have, for many years, warranted the acceptance accorded them by manufacturers and engineers in the field of conditioned air. For complete information, write: *Owens-Corning Fiberglas Corporation, 1912 Nicholas Bldg., Toledo 1, Ohio; in Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*



Dust-Stops for central systems comprise individual parts for each cell: frames, bolts, nuts, gaskets and filters—complete and ready for assembly.

FIBERGLAS* DUSTOP* AIR FILTERS

*T. M. Reg. U. S. Pat. Off.

News of Equipment and Materials

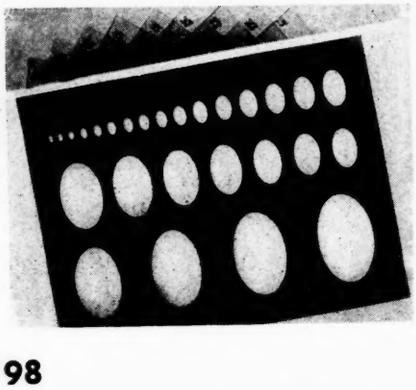
Axial Flow Fans

NAME—Utility fans.
PURPOSE—For ventilation and other applications.
FEATURES—Especially intended for use where quiet is necessary. Fans

have streamlined ring to permit smooth flow of air with minimum turbulence and noise. Enclosed motor, resilient mounted. Belt-driven models have a variable pitch pulley for simple speed adjustment, and adjustable base provides a convenient means of regulating belt tension. All models have welded construction and operate with low power consumption. They are easily installed in wall, window or on panel by the heavy gauge steel ring mounting.
MADE BY—*Utility Fan Corp., 4851 S. Alameda St., Los Angeles, Calif.*

Ellipse Templates

NAME—Lietz ellipse templates.
PURPOSE — For three-dimensional drawings.
FEATURES—Savings up to 50% on time on production of perspectives and isometric drawings said to be effected through precision-cut ellipse templates. Guides are .020 in. thick, of celluloid. Furnished with angles from 15° to 60° by 5° increments. Vertical and horizontal angles are clearly indicated for ready location and adjustment to position. Furnished either in sets or separately.
MADE BY—*The A. Lietz Co., 913 S. Grand Ave., Los Angeles 15 and 520 Montgomery St., San Francisco 11, Calif.*



Air Flow Regulator

NAME—Burklyn adjustable flow regulators.
PURPOSE—Control valve for use in connection with pneumatic tools or other devices for regulating volume of air or fluid flowing from supply line to tool or for use as shut-off valve. Simple rotation of outside knurled sleeve provides positive flow control or regulation. Clockwise rotation opens valve and counter-clockwise rotation closes it. Eight adjustment points are provided for one revolution of regulating sleeve. Each adjustment increases or decreases the opening .004 in., assuring extra-sensitive control. Use of the device makes fine working speed adjustments possible on 1500-13.000 rpm air drills, for example, or on rivet hammers. The regulator may also be attached directly to a supply line carrying air, water, oil or gas, and will hold up to 1500 lb pressure without leaking. Weight is about 5 oz.
MADE BY — *Burklyn Co., Glendale Blvd. & Seneca, Los Angeles 26, Calif.*

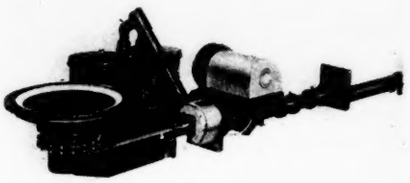
York-Hession Fog Generator

NAME—York-Hession fog generator.
PURPOSE—For producing smoke screens.

FEATURES—Device can blanket any vital area in short time. Machine is so designed as to produce fog without decomposing material from which the fog is made. Fog is non-inflammable, thus eliminating fire-hazard. Has a double pump for gas and fuel oil. For quick starting in cold weather, gas engine is started first, and mercury clutch automatically engages when approximately 2000 rpm is reached. Extremely light, portable, Operated by one man, can cover a square mile with fog in one hour. Generator, fuel, material, and operator can be transported in jeep.
MADE BY—*York Shipley, Inc., York, Pa.*

Winkler ARA Stokers

NAME—Winkler A.R.A. model stokers.
PURPOSE—Hopper and self-feed ash removing anthracite stokers for small commercial requirements.



FEATURES — Feature Winkler Inter-Planetary fully-automatic transmission, which has no shear pin; a rotating burner head, screw type elevator, and Eez Air fly ash reduction control, and other design details. Larger models also feature narrow burners and widely distributed air passage tuyeres. These larger capacity clinkering type units are also available in both hopper and self-feed models. Clinkering type ash residue removal models are being manufactured in larger capacities through 400 lb of coal per hr.
MADE BY—*U. S. Machine Corporation, Lebanon, Ind.*

Time Switches

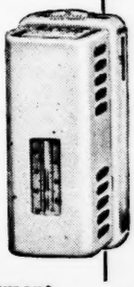
NAME—Lumenite time switches.
PURPOSE AND FEATURES—Company announces a complete line of time switches including low priced economy time switch, deLuxe one circuit and two circuit time switches as well as program clocks, industrial timers and stoker and oil-burner controls. In addition to these regular models, Lumenite is featuring special types for 24 hour and 7 day program controls in which each day may be different.
MADE BY—*Lumenite Electronic Company, 407 S. Dearborn St., Chicago 5, Ill.*

TESTED SWITCH SENSITIVITY!

All White-Rodgers switch units are individually adjusted to uniform tolerances within extremely close limits.

8 EXCLUSIVE FEATURES OF WHITE-RODGERS HYDRAULIC-ACTION TEMPERATURE CONTROLS

1. May be mounted at any angle or position, above, below or on level with control point.
2. Hydraulic-Action Principle incorporating solid-liquid filled bulb and capillary provides expansion force comparable to that of a metal bar.
3. Diaphragm motion uniform per degree of temperature change.
4. Power of solid-liquid charge permits unusually sturdy switch construction resulting in positive contact closure.
5. Heavier, longer-wearing parts are possible because of unlimited power.
6. Dials are evenly and accurately calibrated over their entire range because of straight-line expansion.
7. Controls with remote bulb and capillary are not sensitive to change in room temperature. Accuracy of control is not affected by temperature changes in surrounding area.
8. Not affected by atmospheric pressure. Works accurately at sea level or in the stratosphere without compensation or adjustment.



Another of the many White-Rodgers tests and standards which assure the accurate performance of Hydraulic Action Controls wherever they may be applied.

This, and other testing equipment, has been operating since the first White-Rodgers Control was built — operating to assure accurate temperature control to you — and to safeguard White-Rodgers reputation in the heating and refrigeration fields.

HYDRAULIC ACTION CONTROL

Fuel-Saving Starts With CONTROL

WHITE-RODGERS
ELECTRIC CO.

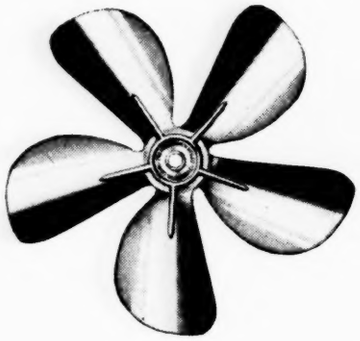
1207G Cass Ave. St. Louis, Mo.

Controls for Refrigeration • Heating • Air-Conditioning

Torrington Fan Blades

NAME—An addition of several new sizes of propeller fan blades to the Torrington Airistocrat and Autocrat line.

FEATURES—To the standard series a



27 degree pitch has been added in the 10 and 12 in. diameters. There is also a new P-1027 in the pressure type fans (P series). An important addition has been made in the Autocrat fans for automobile heaters and similar applications. Size range in this type has been extended to the development of 8 and 10 in. diameters each with 5 blades. A new 5½ in. 5-blade fan, special for some time, is now listed as a standard product in the Airistocrat line.

LITERATURE AVAILABLE—Revised Airistocrat catalog.

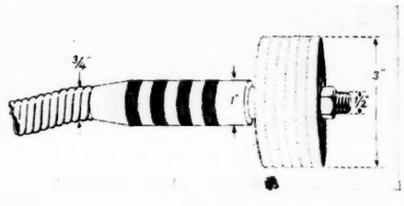
MADE BY—*The Torrington Mfg. Co., Torrington, Conn.*

Boiler Tube Power Brush

NAME — Power brushes for cleaning boiler tubes.

FEATURES—Power brushing, in form of six steel-bristled brushing sections, or wheels, spinning as a unit through tubes, said to make quick work of removing carbon and soot. Equipment consists of a power-driven flexible shaft on which is mounted six 3-inch brushing sections packed with 33-gauge crimped wire. The six sections are held in position on shaft by a locking arrangement. Removal of carbon and soot is accomplished by running shaft, which carries brushing sections, through tubes, with the shaft rotating at 1,750 rpm.

MADE BY—*The Osborne Manufacturing Co., Brush Div., 5401 Hamilton Ave., Cleveland, Ohio.*



Boiler Water Control

NAME—Faratron boiler water control.

PURPOSE — An electronic device for positive and accurate control of both the water level and the firing of boilers.

OPERATIONS — By use of three electrodes of different lengths, mounted in special fitting, directly connected to the boiler, any automatically-fired boiler is under constant control. Electrodes are connected by a cable with electronic unit which can be placed anywhere within 200 feet of the boiler. When water in boiler drops below end of medium length or low level electrode, intake valves are automatically opened or feed-water pumps are started. Water continues to flow in until it contacts the short or high-level electrode when valves are closed or pumps stopped. However, if through failure of water supply or any other reason water is not supplied fire is extinguished by cutting off electric pump or by closing fuel valve. At same time an alarm, perhaps a bell, siren or light, is activated.

MADE BY—*Lumenite Electronic Co., 407 S. Dearborn St., Chicago 5, Ill.*

Flatjet Spray Nozzle

NAME—Flatjet spray nozzles.

PURPOSE—For use where a sharp flat hard-hitting spray is needed particularly for stone and gravel washing, industrial washing, degreasing, and similar processes.

FEATURES — Made of base steel or stainless steel, one-piece construc-

tion. May be used with water, brine, oil, and liquids of similar viscosities.

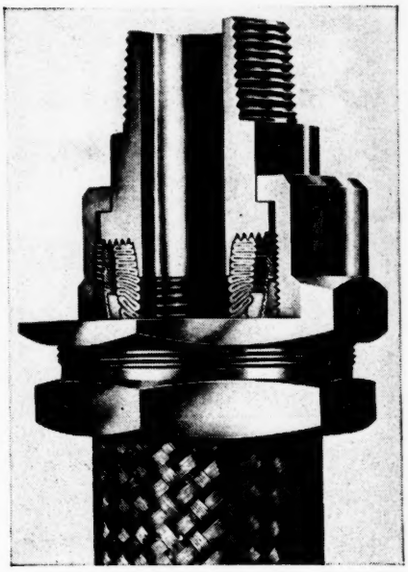
MADE BY — *Spraying Systems Company, 4031 W. Lake St., Chicago 24, Ill.*

Coupling for Hose

NAME—Brass coupling for helical flexible metal hose.

PURPOSE—For providing a detachable, self-sealing, and non-weakening coupling for metal hose.

FEATURES—Consists of four parts, nut, back, stem and split ring. When assembled, convolutions of hose and the metal braid are held by pressure between members as shown in the accompanying view. Coupling withstands pressure tests of up to 800 lb. per sq. in. Has self-contained union which permits pipe-thread end of coupling to be screwed directly into machine fitting and



union tightened without twisting hose.

SIZES AND CAPACITIES—¾ to 1½ in. inside diameter.

MADE BY—*Packless Metal Products Corp., New Rochelle, N. Y.*

R-1000 Respirator

NAME—R-1000 respirator.

PURPOSE—To protect workers against certain dust, fume, and gas hazards.

FEATURES—Device now being equipped with knitted cotton facelets making respirator more comfortable to wear. Facelets can be ordered separately, packed 50 in a box; can be washed and used over again. Will fit most standard design respirators.

MADE BY — *American Optical Company, Southbridge, Mass.*

Aircraft Heater

NAME—Aircraft heater.

PURPOSE—Cabin heating, windshield defrosting, and also engine pre-heating.

FEATURES — Heater is of combustion type burning gasoline from the plane's tanks. In tests has functioned properly at temperatures of —72F and at 40,000 ft. altitudes. In flight heater has hourly output of 90,000 Btu and is said to be quiet in operation.

MADE BY—*Heating Div., Anchor Post Fence Co., Baltimore 24, Md.*

SAVING FUEL IS OUR BUSINESS

Sprague Warner-Kenny, owners of the famous Richelieu brand of quality foods, supplies 60,000 grocers. Its head, Mr. Nathan Cummings. has achieved phenomenal success through his ability not only to build a progressing organization, but also through his skill in eliminating waste. His selection of Iron Fireman firing is a typical example of his ingenuity.

$12,714 a Year Saved for RICHELIEU

★ It's always good business to save fuel. Now it is a good way to serve our country, too. Fuel saving is a wartime "must." So there is a patriotic thrill today for plant owners and engineers who can make a genuine reduction in fuel consumption. Especially when lower costs are accompanied by improvements in boiler room efficiency.

This happened at the Chicago plant of Sprague Warner-Kenny, home of the famous Richelieu brand of quality foods. Steam formerly cost 62c per thousand lbs. After installing Iron Fireman it cost only 26¼c—58% saving. Fuel and labor savings amount to $12,714 a year!

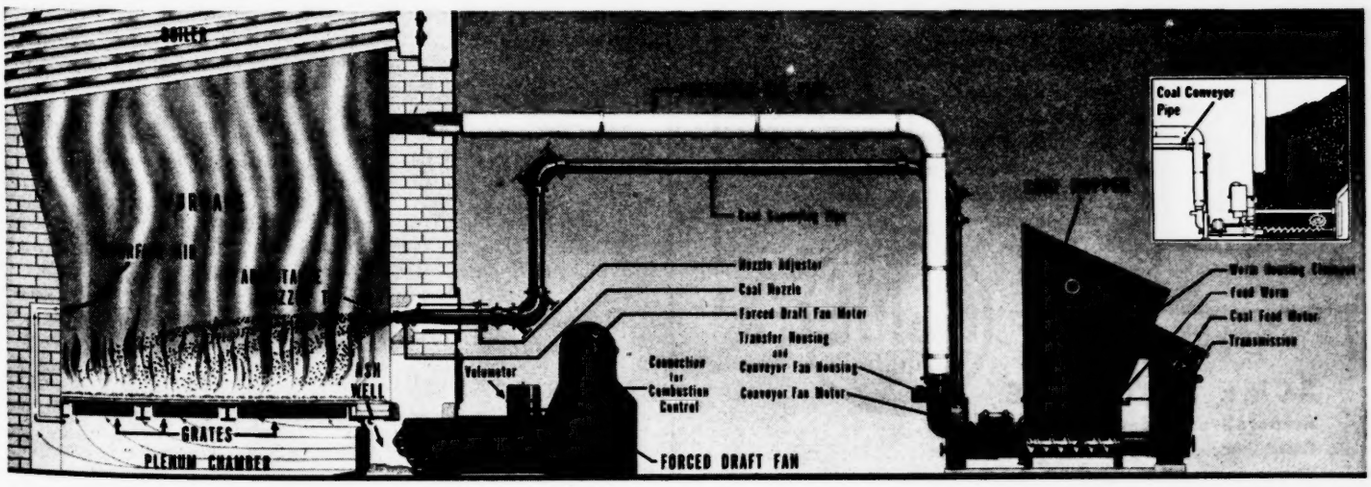
America is a stronger nation because of the job Iron Fireman is doing in the Sprague Warner-Kenny plant. America would be still stronger if a way could be found to make *your* plant more efficient. Perhaps it can be done. Will you give us a chance to study *your* plant at *our* risk?

IRON FIREMAN

COAL STOKERS

THE MACHINE THAT MADE COAL AN AUTOMATIC FUEL

Our nationwide organization of qualified factory representatives and dealers is at your service. For a free survey showing what Iron Fireman firing can do in your building or plant, write Iron Fireman Manufacturing Company, 3091 W. 106th St., Cleveland 11, Ohio.



IRON FIREMAN PNEUMATIC SPREADER STOKER. The Iron Fireman Pneumatic Spreader meters steam size coal from the hopper or main coal bunker to a transfer housing where the coal is picked up by the Pneumatic Conveyor and delivered to the furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow uniform bed. The preheated fines burn rapidly in suspension, greatly reducing the cinder carry-over and materially improving the combustion efficiency and responsiveness as compared with other stokers which do not preheat the fuel.

FOR
Curing the Ills
IN REFRIGERATION
AND AIR CONDITIONING
SYSTEMS

● When a system is sluggish we recommend an **ACME** heat exchanger and oil separator as a cure for this ailment.

When compressor capacity is on the border line for load requirements—these additions to the system will be found highly effective.

Many hundreds of installations in actual operation substantiate this suggestion.

For complete information—write for Catalog No. 12.

ACME INDUSTRIES
JACKSON, MICHIGAN

OIL SEPARATOR

The chief purpose of an oil separator is to remove oil from the discharge gas and return it to the crankcase. An oil separator should return the oil to the compressor crankcase before it reaches the evaporator side of the system. Acme Oil Separators are designed for installation between the compressor and the condenser.
Write for Catalog No. 15.

ACME PRODUCTS

ACME PRODUCTS
Evaporative Condensers, Ammonia Condensers, Freon Condensers, Dry-Ex Water Coolers, Flooded Water Coolers, Hi-Peak Water Coolers, Pipe Coils, Heat Interchangers, Oil Separators, Liquid Receivers, Forced Convection Units, Heat Exchangers. ***Write for Catalog on any item***

NEW CATALOGS

CONTROLS

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

A comprehensive manual, including blueprints of typical installations for steam and hot water heating systems and accompanied by technical data. Incorporated in the manual are eight of the prize winning designs of the $10,000 competition conducted by the company late in 1943 and which illustrate various approaches to the solution of this problem. Standard size, 58 pages.

FUNDAMENTALS OF WATER COOLING

The Marley Co., 3001 Fairfax Rd., Kansas City, Kans.

In this reference Bulletin 806 are presented the theory of atmospheric water cooling, and valuable information on the subject of water coolers. There are several gate-fold pages which have flow diagrams in color to show the cooling and warm water cycles. This bulletin, with its many illustrations, was designed to serve as a reference source.

REGENERATIVE TURBINE PUMPS

Worthington Pump and Machinery Corp., Harrison, N. J.

A standard size 12-page bulletin (No. W-324-B2). Contains sectional illustrations depicting the design of the machine. Also has a number of rating tables for various speeds and cycles.

INDUSTRIAL X-RAYS

North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.

A 4-page illustrated folder S-150 describing the Norelco Searchray 150, a self-contained X-ray for nondestructive examination of specimens for internal flaws, cracks or foreign matter. Folder describes how unit works and explains its applications; photographs illustrate its use in examining aluminum, steel, copper, rubber, plastics, tubes, and other parts.

WELDED FITTINGS

Tube Turns, Inc., Louisville, Ky.

This company has issued a 48-page, plastic bound book, Catalog No. 112, giving dimensions of welded fittings specified in naval and maritime shipbuilding work. It has information on seamless wrought steel and wrought iron fittings as well as wrought carbon molybdenum alloy steel fittings.

Also available is a handy pocket size dimensional data chart which gives complete quick layout information on every welding fitting and flange produced by Tube Turns. Charts spread out to 9 x 24 in.

TESTING MACHINE

Air Reduction Sales Company, 60 East 42nd St., New York 17, N. Y.

A 16-page bulletin describing a portable weld testing machine. The tester operates on the principle of the hydraulic jack. A hand operated pump transmits pressure through a hose to the plunger. Bulletin contains information on the preparation of specimens for tests, and calculation of test results.

ELECTRIC HEATERS

Electric Air Heater Co., Mishawaka, Ind.

A folder, standard size, containing seven 2-page bulletins on the company's line of Electromode air heaters and including a bulletin on each of the following: electric unit heaters, portable heaters, industrial unit heaters, built-in wall heaters, down draft heaters, temperature controls for electric heaters, and price sheet.

PROPER DRAFT CONTROL

Perfex Corp., 400 W. Oklahoma Ave., Milwaukee 7, Wis.

A barometric draft control, described and illustrated in a 4-page folder, is designed to save fuel through proper control of draft. The control unit comes in sizes ranging from 6 in. pipe to 12 in. pipe. The makers claim that the furnace is provided with a steady control.

REFRIGERATION

York Corporation, York, Pa.

A catalog of accessories and supplies for refrigeration and air conditioning plants.

PACKAGED HEAT

Penn Boiler and Burner Mfg. Corp., Lancaster, Pa.

A packaged heat unit developed by this company is described in an 8-page bulletin. The makers claim that with this unit, up to 95% of the usual installation work is saved. They will be ready as post-war merchandise and will go into production as soon as metal is released.

DISCUSSION OF WEAR PHENOMENA

The Nitralloy Corp., 230 Park Ave., New York, N. Y.

A 46-page illustrated bulletin on "Wear, a Discussion of the Mechanism of Wear Phenomena and Influencing Factors." by D. Landau, industrial applications engineer for the company. The author discusses the various problems and factors that enter into the wear of metals. The book closes with a large bibliography on the subject.

GAS BURNERS

Burdett Mfg. Co., 19 North Loomis Street, Chicago 7, Ill.

A 114-page catalog, illustrating and describing Infra-Red Principle Gas Burners and Combustion Equipment, also presenting engineering and reference material. Includes burners, mixing equipment, valves, gas pressure regulators, motors and blowers, pilot safety devices, temperature controls, and electrical accessories. Available only to industrial sales engineers and distributors.

THERMOSTATIC CONTROL VALVES

Lawler Automatic Controls, 453 North MacQuesten Parkway, Mount Vernon, N. Y.

Bulletin C-1 describes and illustrates this company's line of thermostatic control equipment such as temperature regulators, mixing valves and tempering valves. List prices are also included.

PUMPS

The Weinman Pump Manufacturing Co., Columbus 8, Ohio

Standard size bulletin No. 730-B superseding 730-A and devoted to the company's type U non-clogging pumps. Sizes, capacities, installation data, as well as descriptive material and illustrations are included in its 12 pages.

ANNIVERSARY BULLETIN

Underwriters' Laboratories, Inc., Chicago, Ill.

A standard size, 72-page bulletin commemorating the 50th anniversary of the Underwriters' Laboratories and devoted to the history, scope, objectives, and activities of the laboratories.

FLAT LEATHER BELTING

J. E. Rhoads and Sons, Wilmington, Del.

Four-page folder describing the company's belting and leather packings. One page has tables of horsepower ratings for flat leather belting.

WARTIME EXPERIENCE

points to

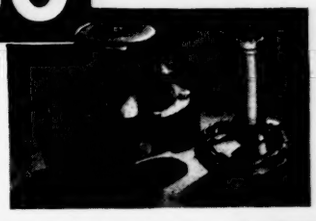
POSTWAR PERFECTION

Since automatic controls are essential to modern, mechanized warfare, the greater part of our production is devoted to turning out vitally necessary precision built equipment.

The specialized skills used to hasten the day of Victory will also serve after the peace is won. When that day comes, knowledge gained from wartime experience will be used to good advantage.

Automatic controls will give the American of tomorrow even higher standards of living and production efficiency than those now enjoyed. We will be ready to maintain our reputation as pioneers and leaders in this field.

B-60 Four New Features

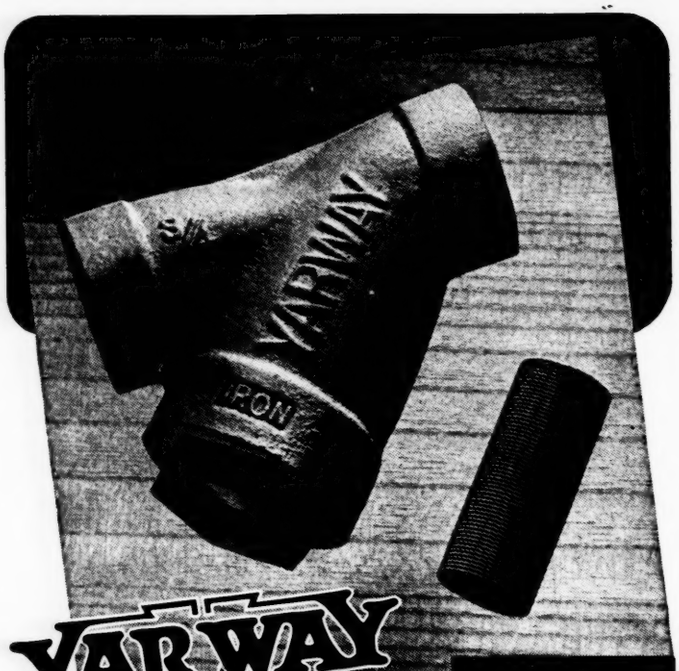


1. Compact, secure, tamper-proof cover
2. Integral pilot valve assembly. Accessible.
3. Strong bodies; hi-tensile iron. High seating pressure and capacities.
4. Securely-locked binding posts. Terminals easily connected.

Write for Catalog 52.

B-60 Gas Controls equipped with heavy-duty pilot generator for liquified petroleum gases. Self-operating, on current from pilot burner thermocouple generator. All parts sealed. B-60 available in Package Set, with Trimtherm thermostat, 30 ft. wire, and generator. Complete, packaged Heat Control. (shown at right)

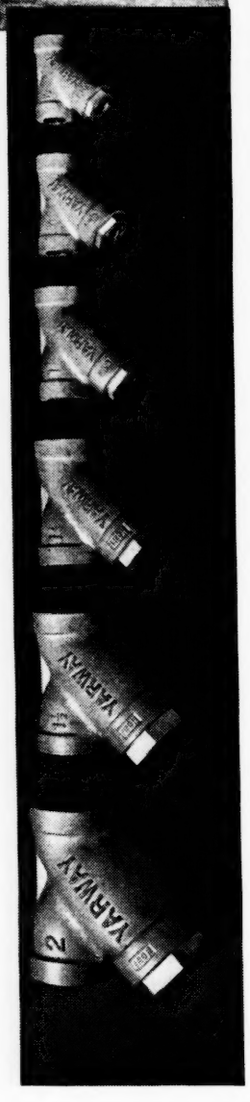
GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF.
Branches: Boston • New York • Detroit • Chicago • Dallas
Philadelphia • Cleveland • Atlanta • Denver • San Francisco



YARWAY

STRAINERS

"Police the Pipelines"



YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

"*The Screen is the Thing*"—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.

Then, too, purchasers like the *body finish—Cadmium plating inside and out* for protection against corrosion.

And last but not least, it is "*Easy to Clean*" having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-200.

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

WITH THE MANUFACTURERS

AIRTEMP DIVISION

Chrysler Corporation, has appointed Harry C. Ashcraft as a district representative in the St. Louis territory. Hayward L. Street has been appointed service representative in the Washington, D. C., office.

THE MARLEY CO., INC.

Kansas City, Kan., has elevated Ray T. Jenkins and Joseph A. Cameron to vice-presidencies. Mr. Jenkins, now general sales manager at the main offices in Kansas City, is succeeded as director of the company's Houston division by Joe T. McKinley. Mr. Cameron continues in charge of the Eastern Seaboard division with offices at 2 Rector St., New York, N. Y.

L. J. WING MFG. CO.

New York, has appointed the following new representatives: Glidden Engineering & Equipment Co., Dallas and Austin, Texas; E. Lloyd Widner, Knoxville, Tenn.; Babcock & Wilcox, Ltd., of Mexico, Mexico City, Mexico; and Sergio Ortiz Toro, Caracas, Venezuela.

BARBER-COLMAN COMPANY

has appointed Wain Engineering Company, Omaha, Neb., as its distributor for control and air distribution products in the Omaha territory.

STEEL HEATING BOILER INSTITUTE

re-elected Homer Addams as president of the Institute at its annual meeting held at Hershey, Pa., in June. Mr. Addams is president of Fitzgibbons Boiler Co., Inc., New York. R. B. Dickson, president of Kewanee Boiler Corporation, Kewanee, Ill. was elected vice-president. W. J. Parker, secretary treasurer and Montie L. Heminway, executive secretary, were re-elected. J. E. Axeman, general sales manager of Spencer Heater Division, Aviation Corp., Williamsport, Pa., was made a member of the executive committee.

The board of directors consists of Mr. Addams; F. B. Hebard, president, The International Boiler Works Co., Philadelphia; A. E. Jennings, Struthers-Wells Corp., Titusville, Pa; A. P. Weiss, Burnham Boiler Corpn., Irvington, N. Y.; J. F. Johnston, president, Johnston Brothers, Inc., Ferrysburg, Mich.; John C. Trefts, Jr., Farrar & Trefts, Inc., Buffalo, N. Y.; J. E. Axeman, John R. Collette, vice-president, Pacific Steel Boiler Division, Detroit, Michigan, and Mr. Dickson. Messrs. Hebard, Jennings and Weiss, retiring board members, were re-elected to the board.

THE EDWARD VALVE & MFG. CO., INC.

has appointed Herr-Harris Co., 545 William Penn Place, Pittsburgh, Pa., as representative in the Charleston and Central West Virginia territory. The Herr-Harris organization has represented the Edward Company in the Pittsburgh area for 25 years. Benjamin M. Herr, head of the Herr-Harris Company, was Edward shop superintendent before forming his own engineering sales and service firm in Pittsburgh.

THE MID-CONTINENT METAL PRODUCTS CO.

announces that it is now the sole manufacturer of the industrial gas burning equipment and Lo-Blast power gas burners formerly manufactured by the National Machine Works, Chicago. These products will hereafter be marketed under the name of National Machine Gas Burners division of Mid-Continent Metal Products Co., 122 S. Michigan Ave., Chicago 3, Ill.

PERSONALS AND PERSONNEL

WALLACE L. NAHIN

Wallace L. Nahin

has recently been appointed general sales manager of The Vilter Manufacturing Co., Milwaukee, Wisc. Mr. Nahin began his career with Vilter after his graduation from Marquette University. He served successively as estimator, application engineer, and field engineer. In 1940, he was appointed district manager of the company's St. Louis office, a position he held till his recent promotion.

H. C. HEUBNER

has joined the Harry Alter Company, Chicago, as sales manager of the appliance division. Starting in 1924 as distributor for Frigidaire in Chicago, Mr. Heubner directed operations there until 1936 when he was sent to the Milwaukee territory as branch manager of Frigidaire. He left Frigidaire in 1938 to become district manager for Easy Washing Machine Company in the twin cities. Since 1939 he has devoted himself to special sales consultant work in promoting products which could be sold during the war period.

EDWARD L. MILLER

has been appointed manager of engineering, in charge of design engineering and research departments, by American Machine and Metals, Inc., East Moline, Ill. He succeeds C. W. Anderson, recently promoted to vice-president and general manager of the company's new subsidiary, U. S. Gauge Company, Sellersville, Pa. Mr. Miller, who has been assistant director of engineering as well as director of design, joined the company in 1927, in Troy, N. Y., as design draftsman for the Tolhurst Centrifugal Division. In 1932 he was appointed chief draftsman of that division and chief engineer a year later.

JOHN J. HALL

has been appointed vice-president and general manager of sales by Richmond Radiator Company. Until recently, Mr. Hall was associated with American Radiator and Standard Sanitary Corporation where he held the title of vice-president, general sales. During the last two years, he has also been connected with WPB in Washington as deputy vice-chairman for industry operations. He resigned from the latter post to return to private industry. Mr. Hall will be headquartered at the newly established general sales office of Richmond Radiator at 535 Fifth Avenue, New York City.

C. E. ("BORIE") LEWIS

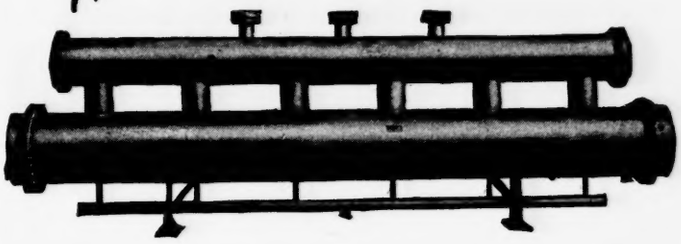
C. E. Lewis

has joined Perfex Corporation, Milwaukee, as vice-president and manager of the controls division. Mr. Lewis comes to Perfex from the Delco Appliance Division, General Motors Corporation, Rochester, where he was general sales manager for the past five years. He originally joined the Frigidaire Division of General Motors, later becoming air conditioning sales manager of Delco-Frigidaire.

(Continued on page 106)

Typifying
PATTERSON-KELLEY
Service and Products

FREON COOLERS
. . . by heat transfer equipment specialists



We understand fully the economics of refrigeration as well as the engineering of the refrigerating system. That's why Patterson-Kelley Coolers for refrigerants — Freon Coolers, for example — are such a good investment. They are designed to meet the economics of each specific installation as well as the cooling requirements of the system. They are designed with comfortable factors of safety. They are neither too small nor too large. To our work in this specialized field we bring several decades of experience in the design and construction of heat exchangers of all types — coolers form an important group.

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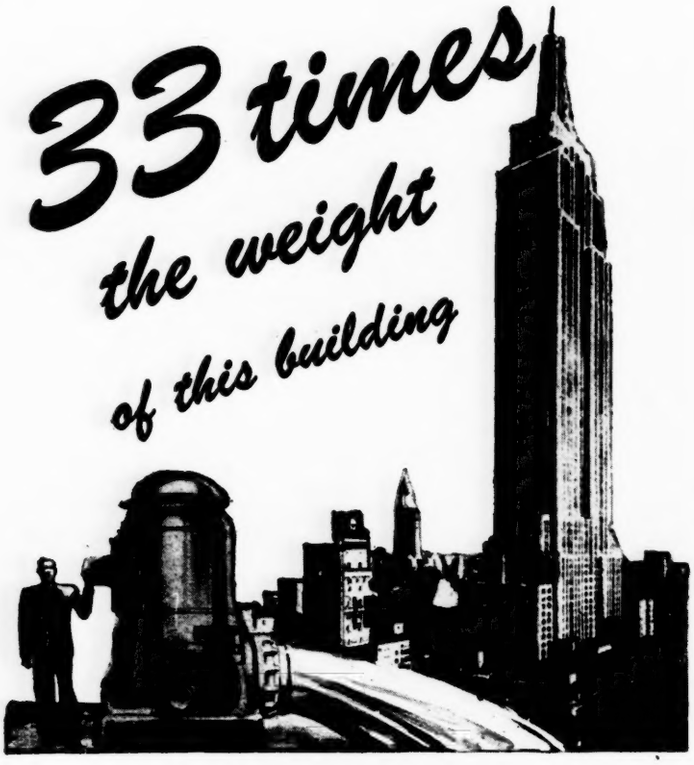
BOSTON 16, 96-A Huntington Avenue • NEW YORK 17, 101 Park Avenue
PHILADELPHIA 3, 1700 Walnut Street • CHICAGO 4, Railway Exchange Building
Representatives in Principal Cities 7-PK-5



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of water annually

A good pump has to take a lot of punishment. For instance, take an average size Peerless Pump producing 5000 gallons of water per minute, lifting it from a deep well, 75 feet straight up. That's a lift of over 1200 tons per hour. In one year this pump lifts 10,957,000 tons. That's a lot of lifting. No wonder so many cheaply-built pumps fail. It takes a Peerless to stand up under such a load, year after year. Peerless precision is worth the effort. Peerless stamina is insurance of economical pump life.

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301 W. Ave. 26, Los Angeles 31, California
1250 Camden Ave., S.W. Canton 6, Ohio
OTHER FACTORIES: San Jose 5, Fresno 16, Calif.

(Continued from page 105)

RALPH C. CAMERON

has been appointed director of merchandising for Airtemp Division, Chrysler Corporation. Mr. Cameron will continue to direct postwar planning activities of the company. The newly created position will place all advertising, sales promotion, and sales training activities of the Division under the supervision of Mr. Cameron. V. P. Black will continue as advertising manager, W. H. Knowlton as sales promotion manager, and Paul H. Dow will be in charge of sales training.

Ralph C. Cameron

Ralph C. Cameron came to Airtemp early in 1942 from Nash-Kelvinator Corp., where he held the position of sales manager of the household division.

OTTO G. TINKEY

was recently employed by Penn Electric Switch Co., Goshen, Ind., as manager of the Company's St. Louis branch office located at 4030 Chouteau Ave. Mr. Tinkey has had more than twenty years of engineering and selling experience in the commercial refrigeration and heating markets.

J. K. GANNETT

vice-president of The Austin Company, who was recently appointed director of engineering and research, has been elected a director of the company to fill the vacancy caused by the death of George W. Plaisted. Mr. Gannett, who served 16 years as eastern district manager of the company, has moved his headquarters to its general offices at Cleveland.

E. LECUREUX

manager, announces the formation of The Fuller-Jones Company, heating and cooling engineers, Box 566, Florence, Ala. The firm will engage in consulting and design work in air conditioning, ventilation, refrigeration and heating. Catalogs and engineering data from manufacturers in these lines are requested.

WILLIAM G. HANCOCK

general sales manager of McCord Radiator and Mfg. Company, has been elected to the board of directors of the Automotive Council for War Production.

GEORGE GULER

has been appointed sales manager of the air conditioning controls division of Minneapolis-Honeywell Regulator Company. Mr. Guler, who has been associated with the company for fifteen years, will make his headquarters at the company's home office in Minneapolis. He will be succeeded in his present position as zone supervisor of air conditioning controls sales in New York by Lou Belford, field supervisor of the company's aero division for the past two years.

George Guler

V. H. HIERMEIER

has been named industrial manager of the St. Louis office of the Brown Instrument Co., Philadelphia. Mr. Hiermeier, who succeeds I. K. Farley, has had 15 years experience in the industrial instrument field.

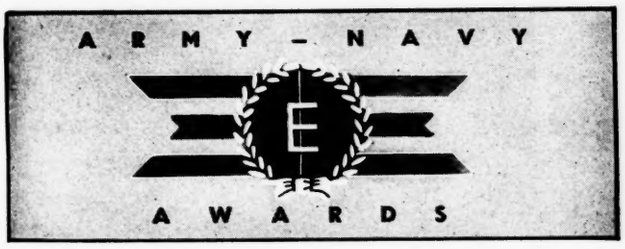
DR. PAUL EDGAR WILLIAMS

director of Jefferson College, St. Louis, for the past 10 years, has joined Owens-Corning Fiberglas Corporation as director of the company's newly-expanded education program. The program is an extension of a training program that has been in effect in the Fiberglas factories for several years. It is designed both for new personnel assigned to positions of responsibility in sales, service, manufacturing, research and other departments, and for present employees holding similar positions who will benefit from a broadened understanding of company policies, and of products, markets and application requirements.

C. B. POOLER

C. B. Pooler

has been appointed vice-president in charge of manufacturing by The Philip Carey Mfg. Co., Cincinnati, Ohio. Born in Fort Dodge, Iowa, Mr. Pooler has spent practically all of his life in the building material industry. An electrical and mechanical engineer, he has served as production manager, plant manager, division operations manager, manager of labor relations in plants producing fabricated steel, metal lath, insulating board, roofing, paints, paper, asbestos, and gypsum products.



American Machine and Metals, Inc., East Moline, Ill. (Third Award)

Summerill Tubing Company, Bridgeport, Pa. (Third Award)

Columbia Steel and Shafting Company, Carnegie, Pa. (Third Award)

Penn Electric Switch Co., Goshen, Indiana. (Third Award)

Kewanee Boiler Corp., Kewanee, Ill. (Third Award)

Burnham Boiler Corp., Zanesville Plant, Zanesville, O.

Kold-Hold Manufacturing Company, Lansing, Mich.

Powers Regulator Company, Chicago, Ill.

York-Shipley, Inc., York, Pa.

York Oil Burner Company, York, Pa.

COMING EVENTS

NOVEMBER 15-19—Third National Chemical Exposition will be held at the Chicago Coliseum, Chicago, Ill. Sponsored by Chicago Section of the American Chemical Society. Headquarters for the show at 330 So. Wells Street, Chicago 6, Ill.

UTILITY Evaporative Air Coolers are available on AA5 or better priority without authorization from WPB, with certain exceptions.

Coolers may be stocked for inventory or re-sale by obtaining approval from War Production Board on Form WPB-547 (PD-1X).

For exceptions and complete information, consult your local WPB office and ask for Order L-38 as amended May 10, 1944.

Utility Propeller Fans and Centrifugal Blowers are also available in accordance with WPB regulations. We will be glad to furnish complete information and literature.

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FAN CORPORATION

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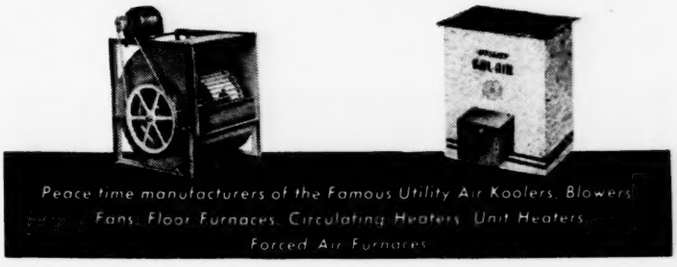
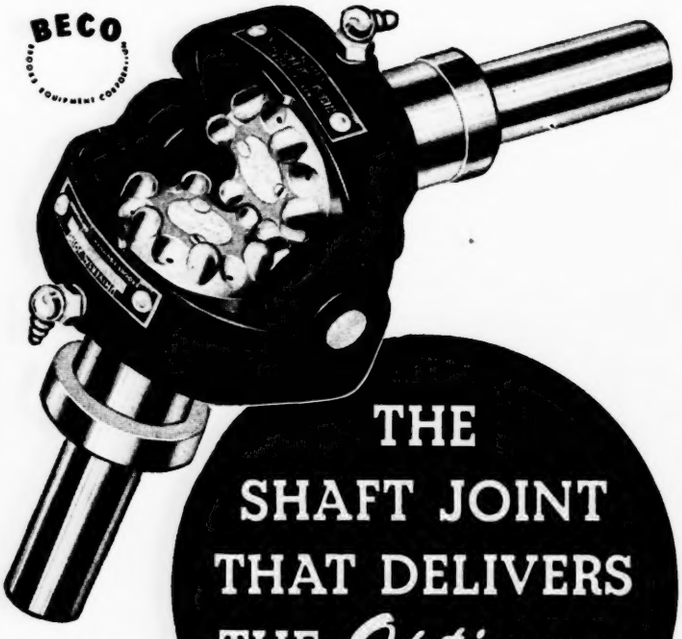


Peace time manufacturers of the Famous Utility Air Koolers, Blowers, Fans, Floor Furnaces, Circulating Heaters, Unit Heaters, Forced Air Furnaces



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Getting Personal

H. J. Kinkade

H. J. Kinkade, author of the current blueprint section (Heat Recovery from Diesel Engines, page 65), is at present manager, Evaporative Cooler Sales, General Sales Division, Fairbanks, Morse & Co., Chicago.

Born in Saskatchewan, Canada, he attended elementary and high school in St. Joseph, Mo. In 1925, he received his B. S. in M. E. from the University of Missouri.

For 6 years, following graduation, he was sales engineer with Armstrong Cork and Insulation Co., and construction superintendent at Pittsburgh, Pa., and Boston, Mass. He was in private business for the next 3 years.

Mr. Kinkade served 2 years with the Kansas Highway Commission, and was for a time with York Ice Machinery Corp.

From 1937 to 1939, he was air conditioning engineer, Fairbanks, Morse & Co., Beloit, Wis.; 1939-1943, chief engineer, Air Conditioning Division. On January 1, 1944, he was advanced to his present post.

Although young engineers, the two authors of Design of Low Temperature Test Cabinets, page 57, have had extensive experience in the low temperature field.

F. C. Frost

T. J. Lopiccolo

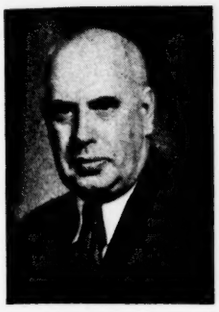
F. Crampton Frost has been with Tenney Engineering, Inc., Montclair, N. J., for over five years, first serving as a design engineer and later as application engineer. Sandwiched in between these two periods were three years with the Liberty Mutual Insurance Company as a construction safety engineer. Mr. Frost graduated from Cornell University in 1935 with the degree of Civil Engineer.

Thomas James Lopiccolo, Vice-President and Chief Engineer of the company, received a B.S. in Chemical Engineering from the Newark College of Engineering in 1939. Since that time he has completed special graduate courses at Stevens Institute of Technology and Columbia University. While attending college he was employed by Tenney Engineering as a student engineer under the college's plan of cooperation with industry. At present he is in complete charge of engineering design, testing and service on all the company's low temperature testing chambers.

It is with some pride that attention is called to a new series of articles on Process Piping in Industrial Plants, page 47, and to the author, **Harry D. Unwin,** for the past three years mechanical engineer with Albert Kahn Associated Architects & Engineers, Inc.

He received his M.E. degree from Cornell University in 1926 and became associated with the gas distribution division of a California public utility. A year later he returned East. For the next 14 years, he served as maintenance engineer, plant engineer and construction superintendent for companies manufacturing linoleum, asphalt roofing, acoustical insulation and other building products. With such a background, it is readily understood why he is so well fitted to write this series of articles.

Either Mr. Unwin is an unusually modest man or we have failed in an assignment. Net result — no photograph of Mr. Unwin.



M. C. Beman

Myron C. Beman (New Power Plant Meets War Demands, page 61) is a member of the firm of Beman and Candee, consulting engineers, Buffalo, N. Y. Born in Binghamton, N. Y., he received his M. E. degree from Cornell University in 1905.

His early experience includes sales engineer, Buffalo Forge Co.; mechanical and electrical engineer for Binghamton Water Works and other local utilities; superintendent, Propeller and Sheet Metal Divisions, Curtiss Airplane Co.; district engineer, Bishop and Babcock Co., Cleveland; Union Iron Works, Erie, Pa.; Massachusetts Blower Co., Watertown, Mass., Reed Air Filter Co., Louisville, and Ilg Electric Ventilating Co., Chicago.

As consulting engineer, he has been in charge of many important projects in New York and Pennsylvania.

Aside from that he has electrical patents for self-playing pipe organs. He is also interested in stamp collecting.

Four years ago he moved to Orchard Park, a village 16 miles from Buffalo, where he traded his golf for lawn mowing. Besides his victory garden, Mr. Beman has become quite an iris fancier. He has two attractive daughters—one in the WAVES, the other a senior at Wellesley.

Charles Hallman

Charles Hallman (Designing Stokers, page 77) is a product of the keystone state. He was born in Phoenixville, Pa., and at an early age, his family moved to Philadelphia. He attended Brown Preparatory School and later Drexel Institute in Philadelphia. In 1928, Mr. Hallman received his M.E. degree from The Pennsylvania State College.

Returning to Philadelphia he was employed at various times by The Badenhausen Boiler Co., Hot Wave Boiler Co., and the American Engineering Co., in the design of power boilers, gas fired boilers, stokers, and kindred power plant equipment.

In 1936, he joined Combustion Engineering, Inc., in New York City, and at present is district engineer at Cleveland, Ohio.

Mr. Hallman has served as technical advisor to Cleveland Fuel Oil Rationing Boards.

A number of interesting topics are to be covered in coming sections of "Blueprint of Post-War Realities."

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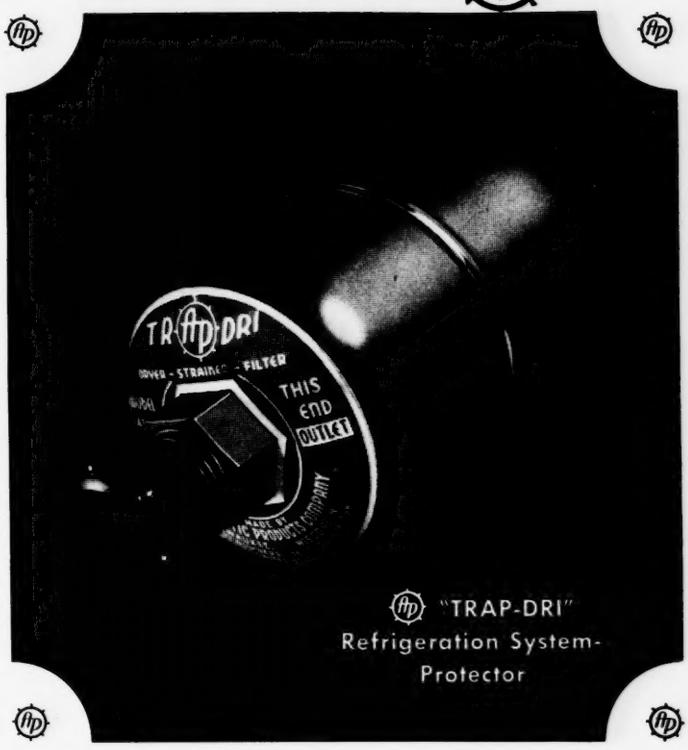

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